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THE ELECTRICAL TRANSMISSION OF ENERGY.

IN the present issue of the ELECTRICAL REVIEW we bring to a conclusion the remarkable series of articles on this subject from the pens of MM. Marcel Deprez and Frank Geraldy respectively. These were originally published in our contemporary *La Lumière Electrique*, and we are much indebted to the Director of that excellent publication for every assistance in bringing the results of M. Deprez's experiments before our English readers. The long and exhaustive labours of this French electrician are of more value than they have hitherto been credited with in this country, and we know of no writings in which the electrical transmission of energy and the characteristics of dynamo-electric machines have been expounded in such a masterly manner as in those of M. Deprez himself.

It will be within the recollection of many that his experiments between Miesbach and Munich and also those undertaken with the assistance of the Northern Railway of France met with a considerable amount of criticism in our columns, and these strictures were, we consider, quite justifiable, for the methods of measurement there adopted were not unimpeachable, and, as will be remembered, the loss on the line due to leakage was ignored. The coupling up of the dynamo-electric machines so as to form a "loop" was an objectionable feature in the Northern Railway experiments, for in this case the greater the leakage on the line, the more favourable became the apparent results. In the most recent of M. Deprez's labours, however, that of the transmission of electrical energy from Vizille to Grenoble, the above objections were eliminated and some very trustworthy data thereby obtained.

The public interest in all matters electrical appears to be just now at a very low ebb; it is not therefore surprising that we hear but little of any other researches on the subject of our present discourse. Indeed, we expect that any valuable additions to our knowledge will again emanate from the experiments of the indefatigable Frenchman, who is, we believe, still energetically labouring at a matter which he has made peculiarly his own.

What will be the ultimate outcome of his labours is for the future to determine, but it appears to us that he has paved the way for really practical applications of the electrical transmission of power. America is probably the most suitable place for demonstrating the practicability of M. Deprez's plans, for there water power abounds, and, to quote from a contemporary, in that country the average capitalist is not endued with the suspicion and timidity which prevails in older countries. We are pleased to have had the opportunity of bringing the results of M. Deprez's work in its entirety before our own countrymen, feeling sure that they have derived considerable pleasure and much valuable information from the perusal thereof.

SUBMARINE CABLES.

(*Continued from page* 368.)

The current will flow from the copper pole through the wire, thence to the earth, and back to the battery, and its working intensity will be dependent on the resistance which the circuit opposes, and can be measured in the following manner:—

Let another battery, but with a much smaller number of elements, be connected side by side with the larger battery to this wire, the zinc pole being connected to the earth and the copper to the wire, and introduce galvanometers in the circuit, between the large battery and the wire and between the small battery and the wire, so as to indicate the direction in which the currents are flowing.

Both batteries will desire to send a current through the circuit in the same way, but should the small battery oppose much less resistance to the passage of a current through itself than is opposed by the long wire, then the greater quantity of electricity generated by the large battery will pass that way in preference to through the wire, and paralyse the action of the smaller battery; but if cell after cell be added to this little battery, when its intensity becomes greater than the resistance of the wire, a current will flow from it also in the same direction as that from the large battery through the wire, and the number of cells requisite just to do this will be an exact measure of the working intensity of the current.

Let the case now be considered where the insulation is not perfect; if there be sufficient leakage to let the small dynamic quantity, which the battery can only generate, escape on the road, no appreciable amount will reach the further end, the tension of the current will be lowered, and a less number of cells in the little battery will now be found to balance it.

Adding to the number of these small pairs of elements will not give any appreciable assistance, but let the surface in each of the cells of the larger battery be increased so that a greater quantity may be generated than can escape through the leaks, represented in the diagram by the dotted lines, an appreciable amount will then reach the further extremity, and the telegraph instrument be rendered active. In such a case as this, adding quantity will raise the working intensity of the current, whilst increasing the intensity of the battery alone will scarcely affect it.

In some experiments tried by my brother, Mr. Cromwell Varley, and myself, on long leaky circuits, increasing the surface of the batteries alone, without adding to the series, raised the deflection on the galvanometer from 22° to 53°; and the last intelligible words uttered by the Atlantic cable, "Daniells are now in circuit," is a further testimony of the correctness of what has just been advanced.

The correctness of considering the inductive phenomena which manifest themselves in subterranean and submarine circuit, as a new fact suddenly brought to light, has been called in question in the early portion of this paper; a few words on its history will therefore not be out of place, before considering the way in which it affects telegraphing.

In 1838, Dr. Faraday pointed out the conditions which would cause the retardation of an electric impulse in its passage through a conductor.

In 1848, the electric telegraph was in actual operation. The method adopted at that time for the insulation of the wires passing through towns, was to enclose a number of cotton covered wires in a leaden tube,

and then fill the tube with a mixture of resin and Stockholm tar.

Reasoning on Dr. Faraday's observations, my brother, Cromwell Varley, was led to think that such circuits possessed conditions favourable for induction to manifest itself; he therefore searched for it, and succeeded in obtaining indications of induction.

In 1849, gutta percha had been introduced, and as the insulation in gutta percha covered wires was much more perfect than in the cotton covered ones enclosed in leaden pipes, induction manifested itself much more strikingly, and my brother made use of from that time as a more searching test of the perfection of the insulation than the deflection of a galvanometer, the capability of the wire to retain for a certain period the induced charge, and he stood alone for some time in making use of this test, others not having faith in it at that period.

In the latter end of the year 1851, my brother was enabled to experiment upon a length of ten miles of gutta percha covered wire. At these experiments I assisted, and the conclusion he arrived at was, that if gutta percha covered wires were employed for circuits of any length, as was at that time proposed, induction would manifest itself so powerfully as to offer serious obstacles to telegraphing with the apparatus then in use, the truth of which prediction was subsequently verified. In Prussia, however, as early as 1850, Mr. W. Siemens had employed gutta percha covered wires for circuits of considerable lengths, and encountered the inductive phenomena, an account and explanation of which he published during that year.

This fact was not known on this side of the channel until after gutta percha covered wires throughout the whole lengths of the circuit were also employed in this country, and that was in the year 1854.

To Dr. Faraday, however, is due the credit, and I have only alluded to its telegraphic history, as I cannot help feeling it as a sort of reproach to practical electricians that it should go forth that induction, which was manifesting itself step by step before their eyes, came suddenly and unexpectedly upon them. The following extract from Dr. Faraday's researches of 1838 is so instructive, and teaches such a valuable lesson, that I cannot refrain from quoting it. Alluding to Professor Wheatstone's well-known experiment, he says :—"If the two ends of the wire were immediately connected with two large insulated metallic surfaces exposed to the air, so that the primary act of induction, after making contact for discharge, might be in part removed from the internal portion of the wire at the first instant, and disposed for the moment on its surface, jointly with the air and surrounding conductors; then, I venture to anticipate, the middle spark would be more retarded than before, and if these two plates were the inner and outer coatings of a large jar, or Leyden battery, then the retardations of that spark would be still greater."

Previous to the first attempt to submerge the Atlantic cable a series of experiments were undertaken by the company's late electrician, and the result published.*

These experiments having been tried, at the expense of much capital, and with opportunities which never before presented themselves, are too important not to be noticed.

The chief results published were these :—

1. That no adequate result is obtained by increasing the sectional area of the conductor; that, in fact, in the case of a submarine circuit—a small wire will transmit signals more rapidly than a larger one.

2. That an insulated submarine wire conducts according to a different law to that of a suspended circuit.

3. That the rate at which a voltaic signal travels is not affected by the intensity of the battery.

4. That magneto-electric induced currents have the property of travelling in the first place faster than voltaic ones; and, unlike voltaic currents, when their intensity is increased their rapidity of travelling is increased also.

In the paper I submitted last March to the Institution of Civil Engineers, I pointed out what I conceive to be errors in these results, and endeavoured to show that some of them necessarily followed from the way in which the experiments were conducted, and I cannot more clearly express what I wish to convey on this head than by quoting my own remarks on that occasion.

"In examining these conclusions, it has first to be considered whether the conditions of a submarine circuit and a suspended one are different. In a suspended wire, the insulating medium of the air takes the place of the gutta percha of the submarine circuit. The earth, which is the nearest conductor, is a considerable distance off, and is only on one side of the wire, therefore but little induction can take place between the wire and the earth; nevertheless, induction does take place, and can be perceived in circuits of very moderate length.

"The author has noticed indications of it in a circuit 60 miles long, and he feels confident that with delicate apparatus it could be perceived in much shorter circuits. If the distance between the wire and the earth were decreased, induction would be developed more strongly, and the wire could be brought down step by step until the condition of a submarine circuit would be approached, where the earth surrounds the circuit on all sides, and is only separated from it by the thickness of one-eighth or three-sixteenths of an inch of gutta percha—a substance possessing, moreover, specifically a much greater inductive capacity than air. It, therefore, appears that the conditions are precisely the same, only differing in degree. Before proceeding further, and to prevent the possibility of mistake, it is desirable to make the following quotation from the work previously referred to :—*

"'The law of squares may possibly apply to the transmission of electricity freely along simple conducting wires, but it certainly does not apply to the case of its transmission along submarine and subterranean gutta percha covered wires (the facility of transmission being estimated by rate of speed) because in this the case is not one of simple conduction, but of transmission, after the wire has been charged inductively to saturation as a Leyden jar.' This quotation shows clearly the reason for concluding that small wires are better conductors for submarine circuits, as far as transmission is concerned, than larger ones; for the smaller the Leyden jar the more quickly will it be charged to saturation. The author, in differing from these conclusions, does not wish it to be understood

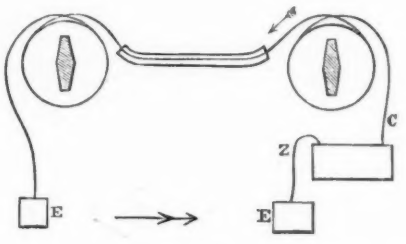


FIG. 5.

that he thinks the law of squares is applicable to submarine wires; but he submits that there is a material difference between a Leyden jar and a submarine wire.

"In a Leyden jar the inner and outer coatings are perfectly insulated one from the other. If they were not insulated there could be no statical charge, as is well understood by all electricians. Induction, therefore, *involves insulation*. But in a submarine circuit this is not the case. If the wire at the further extremity was disconnected from the telegraph instrument, and sealed up with gutta percha, the conditions

* *Vide*, "The Atlantic Telegraph. A History of Preliminary Experimental Proceedings, &c., published by order of the Directors of the Company."

* *Vide*, "The Atlantic Telegraph," page 23.

would be nearly the same. In practice, however, it is quite open through the instrument to the earth, and the resistance opposed by the very long length of wire is the only insulation between the inner and outer coatings, for it unites both, being in connection with the earth at both ends, as shown in fig. 5, where A represents a submerged insulated conductor with a circuit closed through it and the sea. It is evident that if the wire offers no resistance there will be no insulation, and, as a consequence, no induction to retard the passage of the current. It is also equally plain that precisely in proportion to the resistance which the wire opposes, provided always the insulating medium be of the same thickness, will induction manifest itself and retardation be experienced.

"There is also another difference between a Leyden jar and a submarine circuit.

"The Leyden jar is charged uniformly all over, whilst in a submarine wire the tension of the charge varies in different portions of the circuit, being at its maximum at the end where contact is made with the battery, and dying off to nothing at the further extremity."

The next consideration is the part induction plays in submarine circuits of any considerable length.

In a submarine circuit the wire is insulated from the earth by only a thin layer of gutta percha; the conditions, therefore, are favourable for induction through the insulating material; the conductor itself, from its great length, opposes great resistance, or, in other words, insulates to a very considerable extent.

When a battery is connected to send a current, the first impetus is in part directed forward, in part diverted laterally; but as the wire opposes considerable resistance to the passage of the electricity which the battery can generate, whilst the thinness of the insulating material is very favourable for induction taking place through it, the greater portion of the first rush will be occupied in charging the wire statically at the battery end; as, however, it is a balance of forces between the resistance which the wire opposes on the one hand, and the ease with which lateral induction can take place on the other, a very minute portion must pass through instantly, and the period which will elapse between the making contact with the battery and the observing the current at the further extremity will depend upon the capability of the instrument to record very small quantities of electricity.

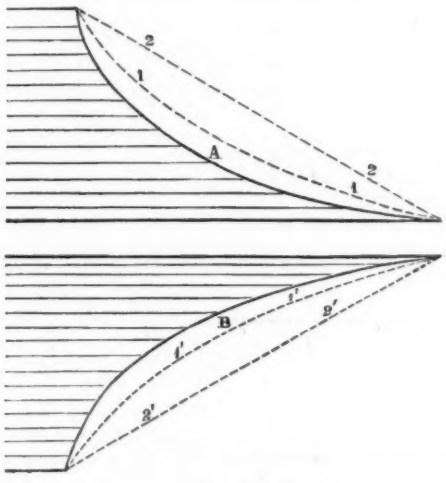


FIG. 6.

In fact, immediately contact is made with the battery, a wave will be formed throughout the length of the wire, somewhat like what is shown in the diagram (fig. 6), which is intended to represent a submarine wire the moment after contract has been made with the battery. The line A represents the internal charge having its maximum tension at the battery end, and diminishing in intensity as it approaches the farther extremity. The line B shows the induced charge of the opposite kind on the outer surface of the gutta percha, and forms an exact counterpart to the internal charge, with the exception of being a little less intense; for as it is spread over a greater surface, and only exactly balances the internal wave, its tension will be less in proportion as its surface is greater. As the tension of the statical charge is raised, so will the flow of electricity at the further extremity increase; both will arrive at their maximum together; the current will then flow in a regular stream as long as contact with the battery continues. The dotted lines, 1, 1, and 1′, 1′, are intended to represent the waves after the contact has been made a short time, and the lines, 2, 2, and 2′, 2′, are intended to represent the waves when they have attained their maximum height.

In the last case they will be perceived to be more regular.

When the battery has been disconnected from the wire, the opposite waves will still continue to unite, but the rate of flow as the tension falls will become slower and slower.

In theory the time which would be occupied by a wire discharging itself completely in this way would be infinite. In practice the wire requires a very appreciable time to charge, and a longer period to discharge. The effect of this is, that if currents are sent at all rapidly one after the other, instead of obtaining a series of distinct impulses at the further extremity, an undulating continuous current is received; and, as to obtain a telegraphic signal, the wire has not only to be charged to a certain degree of tension before an appreciable current is received at the further end, but has also to be discharged afterwards before another signal can be sent, the impulses which are obtained through such circuits as these are very sluggish.

The problem to be solved is the best means of reducing the amount of induction, and of mitigating its effects.

Almost the first remedy suggested when this inconvenience was experienced, was to substitute another insulated wire in the place of the earth for a return circuit, for it was argued that, as in this arrangement, one wire would be charged positively and the other negatively, they would neutralise one another.

This suggestion was put to the test and failed. Since that time the same plan has been revived by several others: a good deal of argument has also been brought forward lately in support of it, and even amongst those who know its practical inutility, there would still seem to have been lurking some faith in the capability of the method (in theory at least) to neutralise the effects of induction.

The explanation of its failure appears to me to be very simple, and I expect not only to make it plain that no advantage is to be obtained by the adoption of this method, but that it will increase the retardation.

FIG. 7.

Let two long gutta percha covered wires (fig. 7), buried in the earth, be connected, one with the zinc pole and the other with the copper pole of a battery, and let the farther ends of each of these wires be hermetically sealed. The earth, from its mass, being a perfect conductor, its action, it is evident, will be the same as if metal tubes in metallic communication with each other surrounded the gutta percha wires. It is therefore clear that the only retardation to induction will be the thickness of the gutta percha covering, and the tension of the statical charge will be in accordance with the intensity of the battery. Now consider the

case of a similar gutta percha wire of the same length (fig. 8) as one of these, but in which one pole of the

FIG. 8.

battery is connected to the earth and the other to one end of the metallic conductor, and the circuit completed by connecting the further extremity to the earth. It will also receive a statical charge to a certain degree, but the tension of the charge will not, *ceteris paribus*, be dependent upon the intensity of the battery, but upon the resistance which the wire opposes, for it has already been shown that this is the only real insulation between the wire and outer coatings, and that the degree to which statical charge can take place depends on the amount of insulation existing.

Now, let the ends of the two wires which are hermetically sealed be connected to each other (fig. 9), the

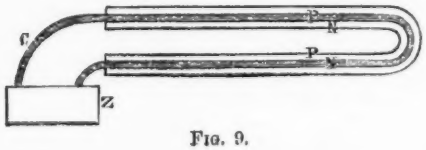


FIG. 9.

circumstances are quite as favourable for induction as in the wire in which one end was connected with the earth, but there will be twice the resistance; in other words, double the amount of insulation, and, consequently, a proportionate increase in the amount of induction.

Another view of this matter will perhaps assist to confirm what has just been stated.

It is a well established fact that when a telegraphic circuit is composed of a loop of wire, it will oppose the same resistance as a circuit of double the length where the earth is made use of in the place of a return wire, and this proves that the earth offers no appreciable resistance. If this be the case, what difference can it make whether the battery pole be carried to the end of the wire itself, or through the medium of any length of a perfect conductor, which the earth has been proved to be. Therefore, it would appear that the induction which would be manifested in a circuit composed entirely of an insulated conductor, would be the same as that in a circuit of twice the length, where one half the circuit is completed by the earth, and the only difference which would exist between the one and the other would be, that in a circuit composed entirely of wire, the statical charge will be distributed more uniformly throughout the entire length.

But, says a writer on this subject, I admit that no advantage would result if two separate wires are used,

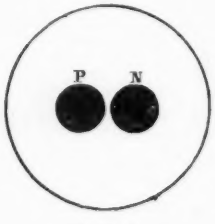


FIG. 10.

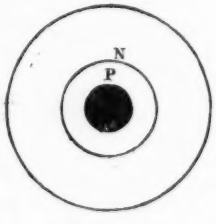


FIG. 11.

and which will therefore necessarily be some distance apart from one another, but place the two wires in the middle of a mass of gutta percha (fig. 10), and so close to each other that they may become virtually the centre of a system, and let the insulating material be of considerable sectional area, then no induction worth naming will take place between the wires and the earth, and the inductive influence of the positive wire will neutralise that of the negative wire.

The fallacy of the proposition will be at once seen if it be carried out more fully. Instead of letting the wires lie side by side, let the one wrap over the other, and be, in fact, a tube with a thin mass of insulating material between it and the inner wire (fig. 11). They will now become really the centre of the system, and fulfil completely the object desired by the author of this suggestion, but is it not evident that such an arrangement is the fac-simile of a Leyden jar, and will not the conditions be the most favourable that can be conceived for the development of induction?

The only remedy which has been successful in mitigating the effects of induction, is that of throwing into the wire, immediately after a current has been sent, another of the opposite kind; this absorbs and neutralises the preceding wave much more quickly than when the wire is left to discharge itself in the ordinary way. This method, however, does not reduce the induction, but only mitigates its effects, although in circuits of moderate length its adoption has, for practical purposes, completely removed the inconveniences arising from the induced charge.

There are only two ways of reducing induction; the one is to increase the thickness of the insulating material, and so render the conditions less favourable for its development, and thus approach the conditions of a suspended circuit, where the induction having to take place through a considerable space of air—a dielectric of very low specific inductive capacity—there is but little accumulation of statical charge, and consequently the impetus is almost entirely directed forward, and scarcely diverted laterally to any appreciable extent. The other way is to increase the sectional area of the conductor.

(*To be continued.*)

M. ESTIENNE'S PROPOSED TELEGRAPH.*

M. ESTIENNE proposes to substitute for the ordinary Morse an apparatus which, whilst possessing the advantages of that instrument, is still more practical and capable of giving a higher speed than that of the well-known Hughes telegraph, without fatigue to the operator.

This new system is described by M. Chenut in *L'Electricien*, and is distinguished from the ordinary Morse by the following points:—

1. A new mode of forming the signals.
2. The employment of a double current key and a polarised electro-magnetic receiver.

The new writing is formed of two signals: the transverse half stroke, which represents the Morse dot, and the transverse stroke, which replaces the Morse dash.

The sketch shows a specimen of this writing.

Each signal is traced by a different pen; the letters, figures and stops are composed of these two signals grouped according to the Morse alphabet. The half stroke is produced by a positive, and the stroke by a negative current.

In this system there is a double reversing key. Each key, when depressed, sends a current through the line in an opposite direction corresponding to a different signal.

Daily experience shows that often an experienced

* This is almost identical with that of R. S. Herring.—EDS. ELEC. REV.

telegraphist in consequence of an involuntary nervousness, finds as much difficulty to work the Morse manipulator correctly for a long time, as a beginner.

This inconvenience which, it seems, is produced even more with a female staff, does not exist with double contact manipulation. The study of the piano, the playing of which also allows of contacts essentially variable in duration, may serve as a proof of this statement.

In M. Estienne's apparatus all the currents are brief, the manipulation is therefore more easy; besides, a too prolonged or too brief contact does not change the nature of the signal, it simply results in a variation of the thickness of the stroke.

Consequently, this system seems to present the following advantages over the ordinary Morse: Diminution of errors, greater facility of manipulation, greater rapidity of working, resulting in an increase of 35 to 40 per cent. in the speed.

M. Estienne claims, moreover, for his system the practical advantage resulting from the reduced space occupied by the signals; the writing is more legible, and the ribbon could be pasted upon the copy, which would relieve the operator from the labour of copying, as at present, without seeing that which he writes, since he is obliged to follow with his eyes at the same time the unrolling of the paper ribbon bearing the signals. Lastly, the considerable economy of paper is not to be neglected.

As for the copies sent to the public they could bear: 1st, the ribbon; 2nd, the translation.

Thus the accuracy could be easily tested.

One of the most ingenious parts of the instrument is the method of inking by capillary action.

The stem of the pallet is terminated by a fork upon the branches of which are jointed two small levers, of which one end is furnished with a stylus or pen in which is fixed a small piece of chamois leather the lower end of which is roughened; the lower part of the stylus or pen dips into a reservoir of ink, which impregnates the leather by capillary attraction. These different organs, of an extreme lightness, are regulated so that the pens are raised and lowered alternately according to the direction of the current, and are brought to the paper at the proper time by the vertical which passes through the axis of the armature.

The supply of ink being, in this system, proportionate to the rapidity of working, one may voluntarily vary the thickness of the signal. This property of the process of inking allows, moreover, by the combination of the Morse writing with the Estienne writing, abbreviations and transformation of consonants into syllables which the inventor calls stenography.

We shall return to this interesting application, which, according to M. Estienne, would allow of further increasing the rapidity of transmission by 20 per cent.

In conclusion, we will mention a small work entitled "Etude sur les transmissions télégraphiques," published by M. Estienne, at the time of the Paris Electrical Exhibition of 1881, in which the author shows the necessity of replacing by a practical means, the counting of the words in telegrams.

The method proposed is very simple; it consists in dividing a dispatch into series of five words, separated by a special signal such as a bar strongly accented, which can be obtained with this system by a single prolonged contact.

If we remember that the number of words which telegraphists have to count annually exceeds two millions, we shall easily understand that the process proposed would considerably facilitate the task of the telegraphist and would also allow the public to verify: 1st, if the number of words of a telegram is correct; 2nd, in case of omission, to prove the gap and to fix the defective point in the phrase. From this point of view the innovation is very important, for it would obtain for transactions made telegraphically a security which does not exist with the present process.

The Estienne system has been tried for several months in Austria and Germany; trials will also be made shortly in Sweden and Holland.

ATKINSON'S FOUR-PLATE TOPLER ELECTRIC MACHINE.

By P. ATKINSON, A.M.

As this machine has the same construction in front as my two-plate machine, a full description of which appeared in the New York *Electrician*, and also in the London ELECTRICAL REVIEW, October, 1883, it is only necessary to refer briefly to its leading features, which will be understood from fig. 1.

It has two glass plates, B, stationary, and supported by hard rubber insulators, while A, placed at a distance of about $\frac{1}{4}$ inch in front of it, revolves in the direction of the arrow, on an axis attached to the post at M, through an opening in the centre of the plate, B, to which are attached the wire brushes, E and F, and the tinfoil and paper inductors, T and X.

In front of A, $\frac{1}{4}$ inch from the glass, are the uninsulated combs, V and H, with their brushes; and the insulated combs, K and L, connected with the Leyden jars, C and D, and the sliding rods, P and R, V and H being screwed to a brass core at the centre of the hard rubber disc, M. And to the plate are attached six discs or carriers, two of which are seen at W and Z.

These parts, with a driving wheel and belt, mounted on a base, constitute the points of resemblance between this machine and others of the same class. The points of difference, covered by patent, are as follows:—

1. The outside coatings of the Leyden jars, C and D, are of sheet brass, forming cups, screwed firmly to the base, into which the jars fit closely and are thus held in a fixed position, affording a firm support to the plates connected with them.

2. The induced current from these outside coatings is conveyed down by the screws which attach them, and along copper wires underneath to the terminals of the switch, S, through which, when closed, it flows from one jar to the other; but, when open, as in the cut, it passes by the brass sockets seen on the edge, out through the conducting cords, and a person, or other object connected with their outer extremities. As this induced current flows simultaneously with the direct current from the inside coatings, the switch and sliding rods place it completely under control of the operator, either for medical or scientific purposes. With the switch open a slight separation of the electrodes, P and R, produces a smooth, gentle current, which may be increased to any desired strength by increasing the distance between P and R.

3. The brush-holders, E and F, are attached to the plate, B, through holes near its edge, giving a direct passage to the electricity from the carriers on A, where it is generated, through the glass, to the inductors, T and X, thus interposing an insulating margin between the brush-holders and the edge, and preventing loss from leakage, unavoidable when the attachment is made by clamps on the edge.

4. The carriers on the plate, A, are of brass, nickel plated, with raised centres, making them durable, ornamental and permanent, without any possibility of becoming detached from the glass, or defaced, like carriers with centres put on over tinfoil bases.

5. The combs, V and K, also H and L, radiate at an angle of 45° to each other from the central disc, M, to which they are permanently attached, thus avoiding all possibility of error in position or of displacement.

There are numerous other improvements of minor importance, to which it is unnecessary to refer specifically.

The four-plate machine has the same construction in front, but a special construction for the two rear plates, which will be understood by reference to the cuts.

The end view, fig. 2, shows two pairs of plates, the position of the rear pair being reversed, which brings the stationary plates into the centre, back to back, between the revolving plates, so that the inductors are on the inner faces of the stationary plates, and the carriers on the outer faces of the revolving plates,

which, being mounted on the same shaft, with a collar between them, revolve in unison.

The combs, L and K and V and H, have curved rods attached to their ends, which pass round the plates and support duplicate combs in the rear, as shown in figs. 2 and 3. The brushes are also duplicated, as shown in the cuts; so that with the exception of the Leyden jars and switch, and parts directly connected with them, this is practically, a double machine.

Its mode of action is the same as that of the two-plate machine, and the leading points may be briefly noticed as follows:—

The friction of the brushes, F and E, with the raised centres of the carriers, as the plate, A, revolves, generates an initial electric charge. Following any two carriers, as W and Z, we notice that this charge passes, by the brush-holders, through the stationary plate, B, and along the tinfoil strips, shown by the dark shade, to the inductors, T and X, on its rear face. So that, at the instant of the contact, the potential of all these parts is raised to the same degree; but at the next instant the contact is broken, and carriers and inductors being insulated from each other, the initial charge, produced by friction, is increased by their mutual induction.

When W and Z arrive at the insulated combs, L and K, a transfer of electricity takes place between the carriers and Leyden jars, through L and K. But the potential of carrier W, and inductor T, is higher than that of carrier Z and inductor X, from the better insulation of the brush-holder, E, on the upper half of the plate, B; free from the inductive influence of the Leyden jar and other parts in close proximity with the brush-holder, F. This difference of potential is further increased by the induction of the earth, which condenses the electric charge on the lower ends of the inductors, T and X, a portion of which escapes from X through the brush-holder, F, while the lower end of inductor T has no similar outlet. Hence the potential of the inner coating of the jar D becomes higher than that of the jar C, making it positive, and repelling electricity from its outer coating, making it negative. Hence, when W and Z are opposite L and K, the flow of electric energy is from the carrier W and adjacent parts of the plate, A, through the comb, L, to the inner coating of jar D, and from the inner coating of C through the comb K to the carrier Z and adjacent parts of A. Hence the inner coating of D becomes positive, and that of C negative, the potential of the outer coatings being the reverse.

When the difference of potential between the inner coatings becomes sufficient to overcome the resistance of the air a discharge takes place from R to P, and, at the same instant, a discharge from the outer coatings takes place in reverse order through the switch and connections from C to D.

The discharge from R to P may be increased to several inches, varying according to the capacity of the machine. The lower discharge may be observed by opening the switch, when the sparks will be simultaneous above and below; but when it is closed the lower discharge takes place silently; and the same is true when the switch is open and the connections are made through the conducting cords and a person holding the handles, as in fig. 1; when a current similar to the Faradic is felt, the strength of which depends on the distance to which P and R are separated; $\frac{1}{32}$ inch giving a mild current, and $\frac{1}{4}$ inch as strong as can be borne without undue severity.

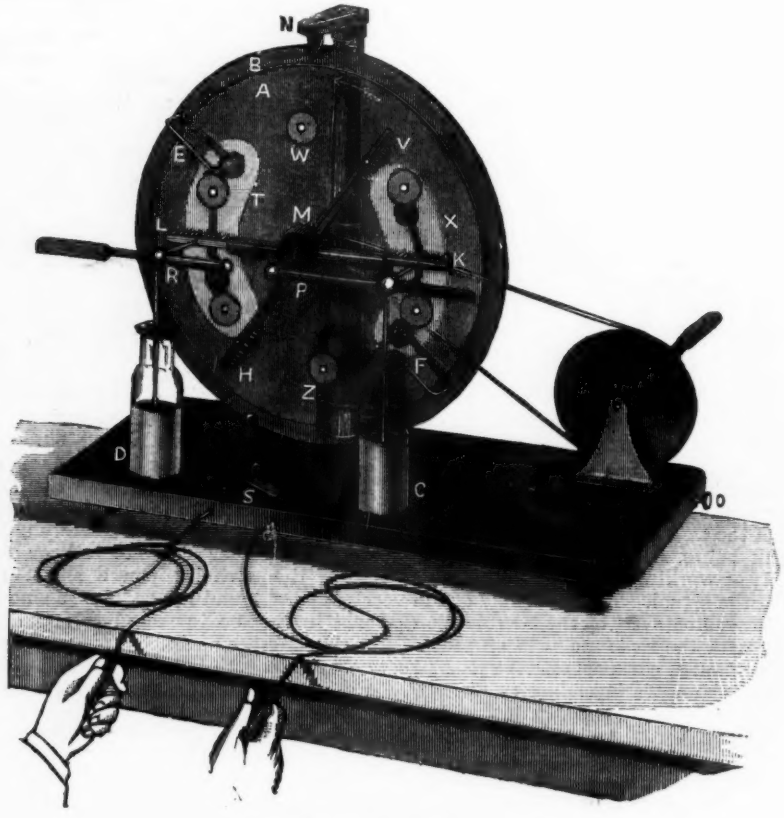


FIG. 1.—FRONT VIEW.

Following the carriers W and Z, after they leave the insulated combs L and K, we find that as they approach the uninsulated combs H and V, W has a negative potential from having given up electricity to L, while Z is positive from having received electricity from K; and the intensity of these conditions is increased by induction from the opposite electric conditions of the inductors T and X. As W passes under the comb H, and is brought into contact with its brush, Z passes under V, and is touched by its brush; and a silent discharge takes place from Z to W through the combs V

and H, which are in electric connection through the brass core of M, and the equilibrium is restored, so that they approach the brushes F and E in a neutral condition, as at first.

It should be noticed that the electric charge is instantly diffused over the metal carriers and inductors, more slowly over the paper inductors, and still more slowly over the shellaced surfaces of the glass plates. So that when the machine is put in action, after a considerable interval of rest, three or four seconds elapse before it becomes fully charged, and a crackling sound is heard from the electricity forcing itself over the resisting surfaces of the paper and glass. The surfaces of the plates, on which the carriers and inductors are mounted, assume the same potential as the carriers and inductors attached to them, while their opposite surfaces have the reverse. Opposite parts of the same surface are also in opposite electric states; the section L, M, H, for instance, having a potential opposite to that of V, M, K, the action of the combs changing the potential of the surface simultaneously with that of the carriers and inductors, as already described.

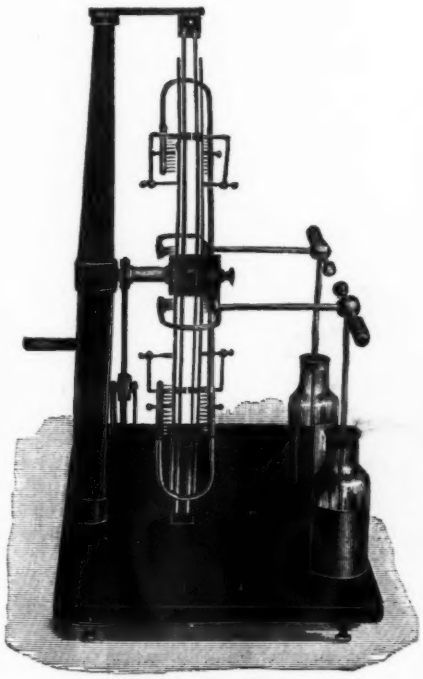


FIG. 2.—END VIEW.

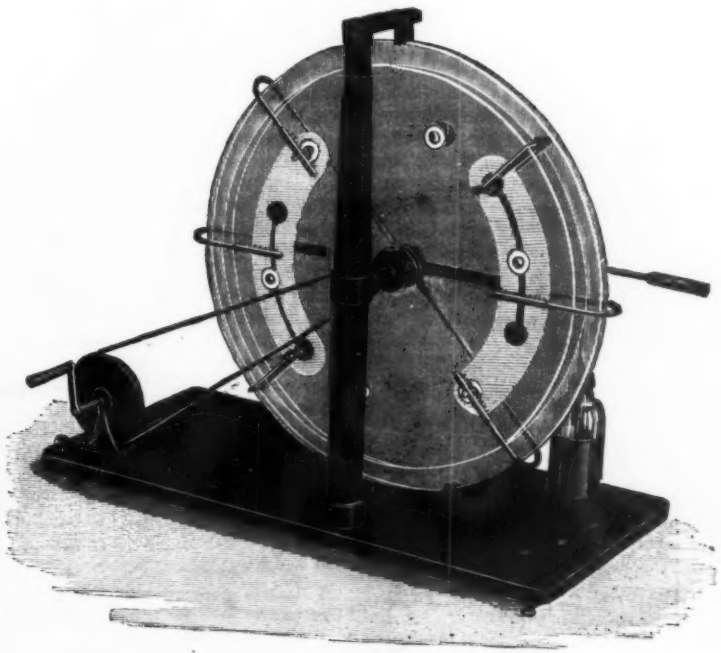


FIG. 3.—REAR VIEW.

It will be noticed that the office of the brushes E and F is the reverse of that of H and V. E and F *generate by friction*, while H and V *discharge by contact*. And, while the combs K and L aid in creating a difference of potential, the combs H and V aid in restoring equilibrium.

In the description of my two-plate machine, already referred to, it is stated that "better results have been obtained by increasing the size rather than the number of the plates." This was written immediately after the construction of a four-plate machine with movable and stationary plates, alternating in position, and only the same number of combs and brushes as in the two-plate machine, relying on the induction of the two additional plates for increase of energy.

The experiment was a failure, the energy being little, if any, greater than from two plates. But the energy of my present four-plate machine is more than double that of a two-plate of the same size. It gives easily, without any resort to the drawing out process, 65 sparks, 6¼ inches long per minute, while a two-plate machine of the same size—plates 25 and 28 inches diameter—gives but 30. The five extra sparks above double the number, may be accounted for by the better insulation of the duplicate combs and brushes. These are thick sparks, with the snap of a revolver to them, showing great intensity.

This is a very rough, inaccurate method of measurement, and the results are, of course, only approximate; but they are the best that can be obtained, in the absence of expensive instruments, and give a good general idea of the comparative energy of the two machines.

A galvanometer is useless for the measurement of static electricity, as the best wrapped wire will not insulate it; and it is doubtful whether a quadrant electrometer, as ordinarily constructed, would have sufficient insulation to measure electricity of such tension as to give sparks nine or more inches in length, and to perforate easily a glass jar ⅛ inch thick.

A voltameter is generally useless, as little, if any, perceptible electrolysis can be obtained even from static machines of great energy. This is generally attributed to their small quantity compared with their great tension, and with the electrolysis obtainable from galvanic electricity, in which these conditions are reversed. An accurate and more practical means of measurement could probably be found in the amount of force required to rotate the plates, which increases in the proportion of their size and number.

But the spark is commonly relied on for measurement, and a very erroneous impression prevails that *length* of spark is a correct criterion. But *frequency* and *intensity* are as important as length. Long, thin sparks of small intensity may be obtained at considerable intervals from machines of very limited capacity.

Length, frequency, and intensity are the three factors to be considered. The first two can be accurately measured, but the intensity must be inferred from the apparent thickness of the spark, the loudness of the report, and the ability to penetrate glass, paper, or other dielectrics. And in the light of these facts the superior energy of my four-plate machine becomes at once apparent.

The smoothness of the induced current, and the constancy of the charge, are points of great importance in this machine, especially in medical practice, where static machines are now extensively used.

This current from the outside coatings of the Leyden

jars, as already explained, is superior in smoothness to that obtainable from the best Faradic battery, and may be varied by separation of the sliding electrodes, from a current mild enough for an infant to one powerful enough for a giant.

It will be understood that this current consists of a rapid succession of impulses, produced by the charge and discharge; and, in small machines, the requisite energy is obtained by increased separation of the sliding electrodes, producing increased intervals between the impulses, during which the energy accumulates, which makes the currents jerky and disagreeable, while in this machine the same energy is obtained at much shorter intervals, giving the impression of continuity; so that, with a mild current, the separate impulses are imperceptible. It is the difference between a musical note and the whirr of a buzz saw.

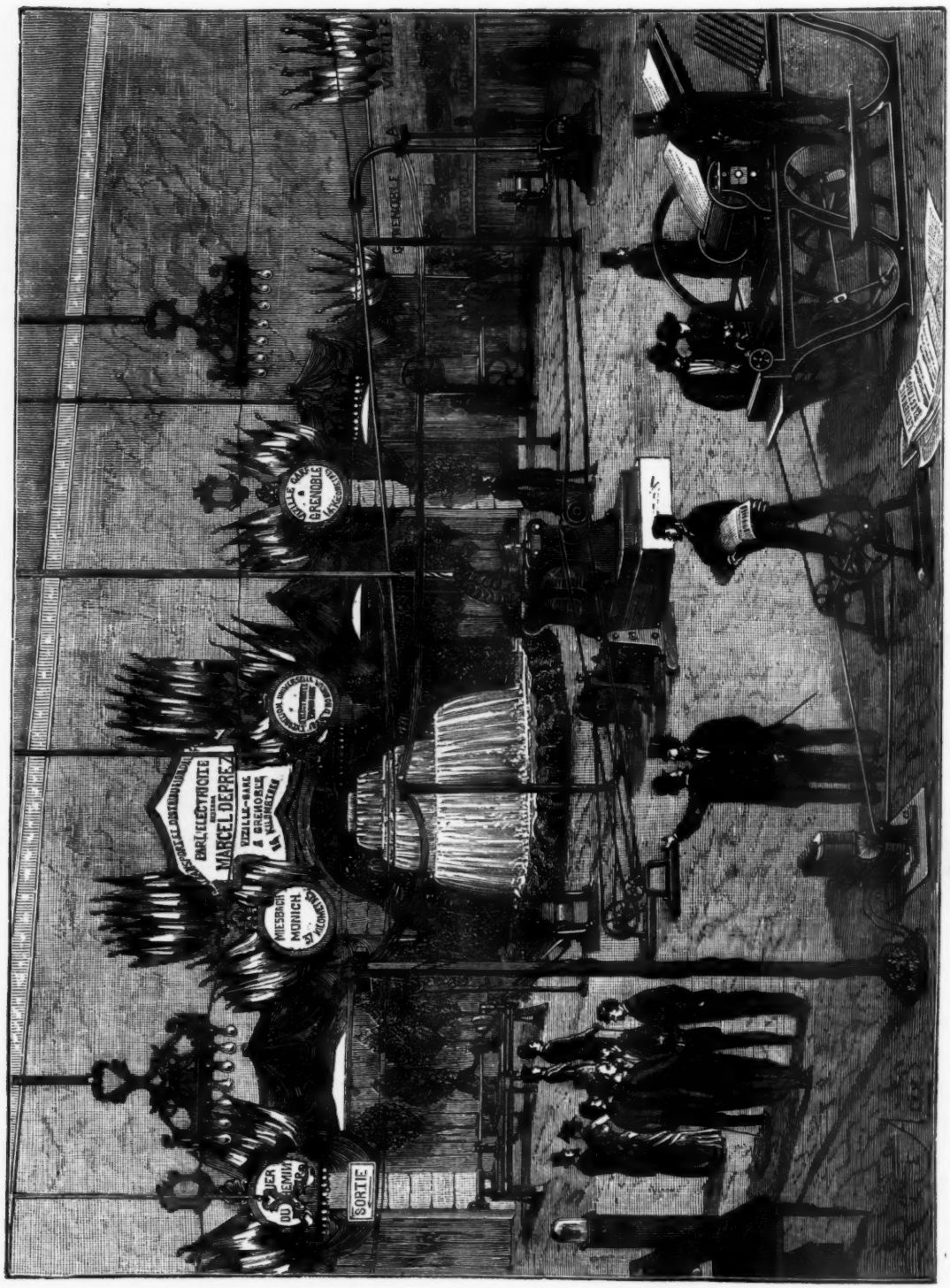


FIG. 18.—INSTALLATION OF THE DISTRIBUTION OF POWER AT GRENOBLE.

The constancy of the charge is shown by the fact that a residual spark may be obtained even after the machine has remained unused 37 hours in a cold room, and on putting the plate in motion a full charge results almost instantly.

This will be appreciated by any one who has

attempted to operate a Holtz machine under unfavourable circumstances. My attention was recently called to a self-inciting Holtz in use in a large medical establishment, where the physician informed me that it often required three hours' manipulation to charge his machine, while mine charges itself in the same number of seconds.

[This article appeared in the *Electrical World*, of March 29th, and we are indebted to the courtesy of the editor of that journal for figs. 2 and 3.]

ordinary, or rather inferior, condition, and that in an installation where the losses threatened to be inconvenient, it would be easy to diminish them greatly by taking extra precautions.

The experiments relating to the transmission were quite sufficient from a dynamo-electric point of view; there is added a summary of the electric elements so as to give a complete notion of this transmission.

This was the whole result which it was proposed to obtain. The Commission, however, wished to go further, and requested the engineers in charge to add to transmission that of distribution. This did not enter into the programme. It was quite impossible to effect a distribution at a distance, as nothing had been arranged

L'ÉNERGIE ÉLECTRIQUE

Journal universel d'Electricité

Directeur scientifique : Marcel DEPREZ ; NUMÉRO UNIQUE. Rédacteurs : Frank GÉRALDY, Jules SARCIA.

Grenoble, le 3 septembre 1883.

A Monsieur MARCEL DEPREZ

LA DISTRIBUTION ELECTRIQUE DE LA FORCE

CHEMINS DE TRANSPORT ET DE DISTRIBUTION DE FORCE

DE VIZILLE-GARE A GRENOBLE (19 kilomètres)

L'AVENIR

LE TRANSPORT ELECTRIQUE DE LA FORCE

TRANSPORT & DISTRIBUTION DE L'ENERGIE PAR L'ELECTRICITE

HISTORIQUE DE LA QUESTION

[FIG. 19.—REDUCED REPRODUCTION OF THE JOURNAL PRINTED AT GRENOBLE BY MEANS OF THE TRANSPORT OF ENERGY.

THE ELECTRIC TRANSFER OF ENERGY.

RESEARCHES OF M. MARCEL DEPREZ.

Summary of Experiments.

By FRANK GERALDY.

Translated from *La Lumière Electrique.*

(*Continued from page* 372.)

As for the theoretical deductions which may be drawn, it must be remembered that the line used at Grenoble was in the most

for that purpose. It is known, in fact, that in order to effect this distribution of electricity, M. Marcel Deprez used machines having two coils, the one of which received a current proceeding from a special exciter, or from a derived current taken from the working circuit. The generator at Vizille had not two coils, and there was no suitable exciter. There were no receivers which could work with currents at a high tension. In short, nothing could possibly be done in the way of a distribution effected from Vizille, which, we repeat, had not been in question. All that we had of this kind was the old material which had been used in the Exhibition of 1881, which might serve to effect a distribution on the spot. It was sent for, which was all that could be done to

satisfy the Commission. It was necessary to arrange this distribution at Grenoble with a special motor. The idea was then taken up of using as a motor the receiver of the transmission. It was remarked at once that this arrangement was incomplete, and could not be adapted to measurements. In fact, to effect distribution requires that the generating machines should always be worked at the same speed, whatever the work required. This presupposes a motor fitted with a regulator, and always retaining its velocity.

This was not the case with the receiver, which, according to the duty imposed upon it, slackened or accelerated its speed. Still this distribution, effected by a double electric transformation, was a brilliant experiment, well calculated to strike the public, and it was fitted up accordingly. Fig. 18 gives an idea of the workroom thus organised. The receiver in the middle of the hall worked on the one hand the pump feeding the cascade, and on the other the two generating machines for the distribution. The current produced by the latter went round the hall, giving off at different points derived currents, supplying small Siemens machines, which worked a lathe, a saw, a printing-press, and a glow-lamp. All these implements acted effectively and independently. On the press was struck off a single number of a journal describing the experiments, fig. 19. The whole was thrown open to the public, and acted daily with great regularity, from 2 to 4 p.m. The work collected was about 6 horse-power.

On coming to the experiments of distribution, as a motor of a regular speed was required, a locomotive was substituted for the receiver. It was thus proved that the distribution was effected with very satisfactory regularity.

To complete the demonstration of the applicability of transmitted electric energy to all uses an illumination was got up. The hall was lighted with 108 Edison lamps, forming nine groups of 12 lights each. On the other hand, at Vizille, a group of 12 lamps illuminated the machine, and served as evidence. Fig. 20 gives an idea of the station of departure, and 21 shows, very imperfectly, the fine effect of the hall lighted up and filled with an admiring crowd.

The machines were then taken down and sent off in a perfect state of preservation, ready for resuming work.

In addition to the striking numerical results found and reported there was obtained by these researches a great sense of security. All who had been present at this experiment, so prolonged that it might be regarded almost as an industrial application, went away with the conviction that the practical period had opened, and that success was ensured.

Some time after the end of the trial M. Marcel Deprez received the following document from Grenoble :—

"*Extract from the Register of the Municipal Council of Grenoble.*

"The Mayor made the following communication to the Council :—

"Gentlemen,—I have the honour of depositing at the office of the Council a copy of the report of the commission appointed to examine the experiments which took place at Grenoble in September last on the transmission and distribution of power by electricity by M. Marcel Deprez.

"By occasion of this report, which has been distributed to you, permit me to remind you that the experiments in question have fixed the attention of the learned and of the industrial world, and that they have been the subject of an official communication at the Academy of Sciences. The eminent perpetual secretary concluded his note with the following words, which I have pleasure in reproducing :—

"'These new experiments have been completely successful, and the town of Grenoble may claim the honour of having taken the first step in a path repeatedly marked by the encouragements and the good wishes of the Academy of Sciences.'

"In order to consecrate the memory of these experiments, I have the honour of proposing, gentlemen, that you express your gratitude to the illustrious savant who has chosen your town to give there a public proof of the results of his precious discoveries.

"The proposition of the Mayor was put to the vote and carried unanimously.

"EDOUARD REY,
"Mayor of Grenoble."

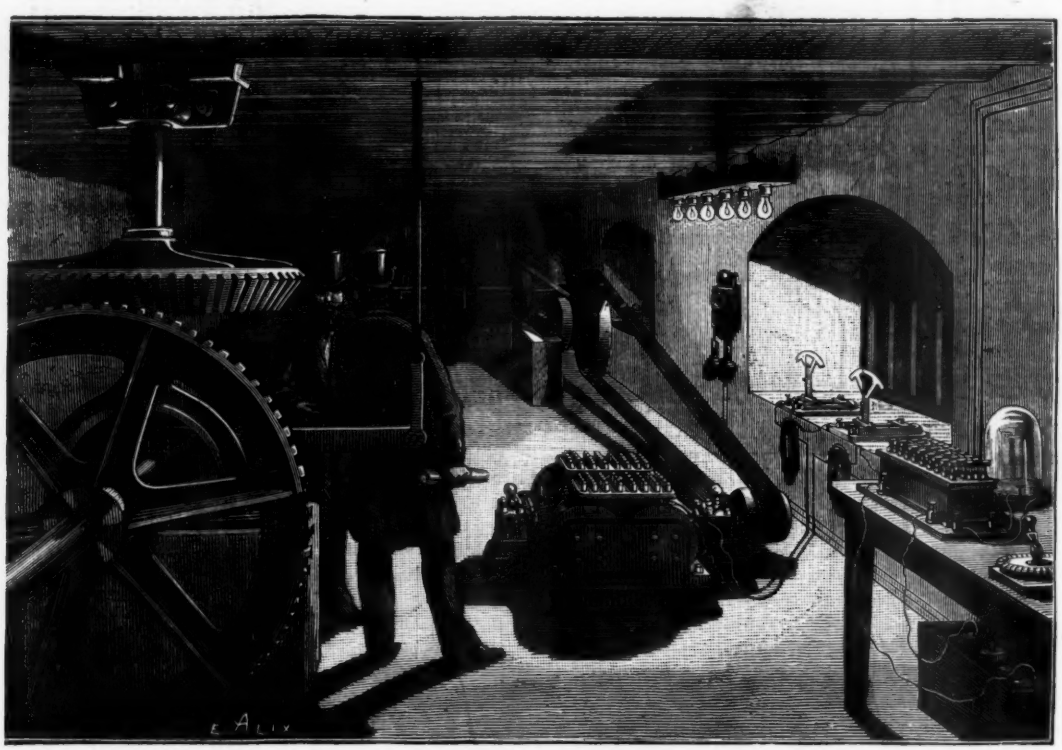


FIG. 20.

ON HALL'S PHENOMENON.

By AUGUST RIGHI.

INVESTIGATIONS still in progress on this important phenomenon have led me to results of which I feel it my duty to give a sketch, whilst reserving for the future a complete description of my experiments.

The first of these results concerns the plate employed. Instead of, as it has been customary, cutting this in the form of a cross, I leave it in any shape whatever, and instead of four I apply three electrodes, distributed arbitrarily. The current enters through one of these, and makes its exit through the other two, after having divided itself into two branches in the plate. These two branch-currents, before re-uniting in a wire, traverse in opposite directions the bobbins of a galvanometer, which is rendered almost astatic by means of a magnet. Each of these bobbins has two wires, and each of the two branch-currents traverses one of the wires of each bobbin. A suitable resistance introduced into one of the two branch-currents, or one or two

bobbins traversed by the entire current, serves to compensate the action of the two branch-currents, so that on closing the circuit containing the plate the little mirror of the galvanometer changes its position either not at all or very slightly.

If the plate is introduced between the poles of an electro-magnet in which the current of a powerful battery is inverted, Hall's phenomenon is manifested by galvanometric deviations, which have their cause in a modified distribution of the current in the plate under the influence of the magnetism. We find the direction of the deviation for gold and those metals for which Hall's effect has the same sign if we conceive that the lines of equal potential in the plate undergo an angular deviation opposite to the direction of the current circulating around the electro-magnet, and for those metals for which Hall's effect has the opposite sign to gold, an angular torsion in the same direction as the current in the electro-magnet. If, therefore, *e.g.*, the current enters into a gold plate by an electrode on the left, and takes its exit by two electrodes on the right, the one above the other, and circulates in the electro-magnet (between whose poles the gold plate is introduced) in the direction of the hands of a watch, the current in the plate

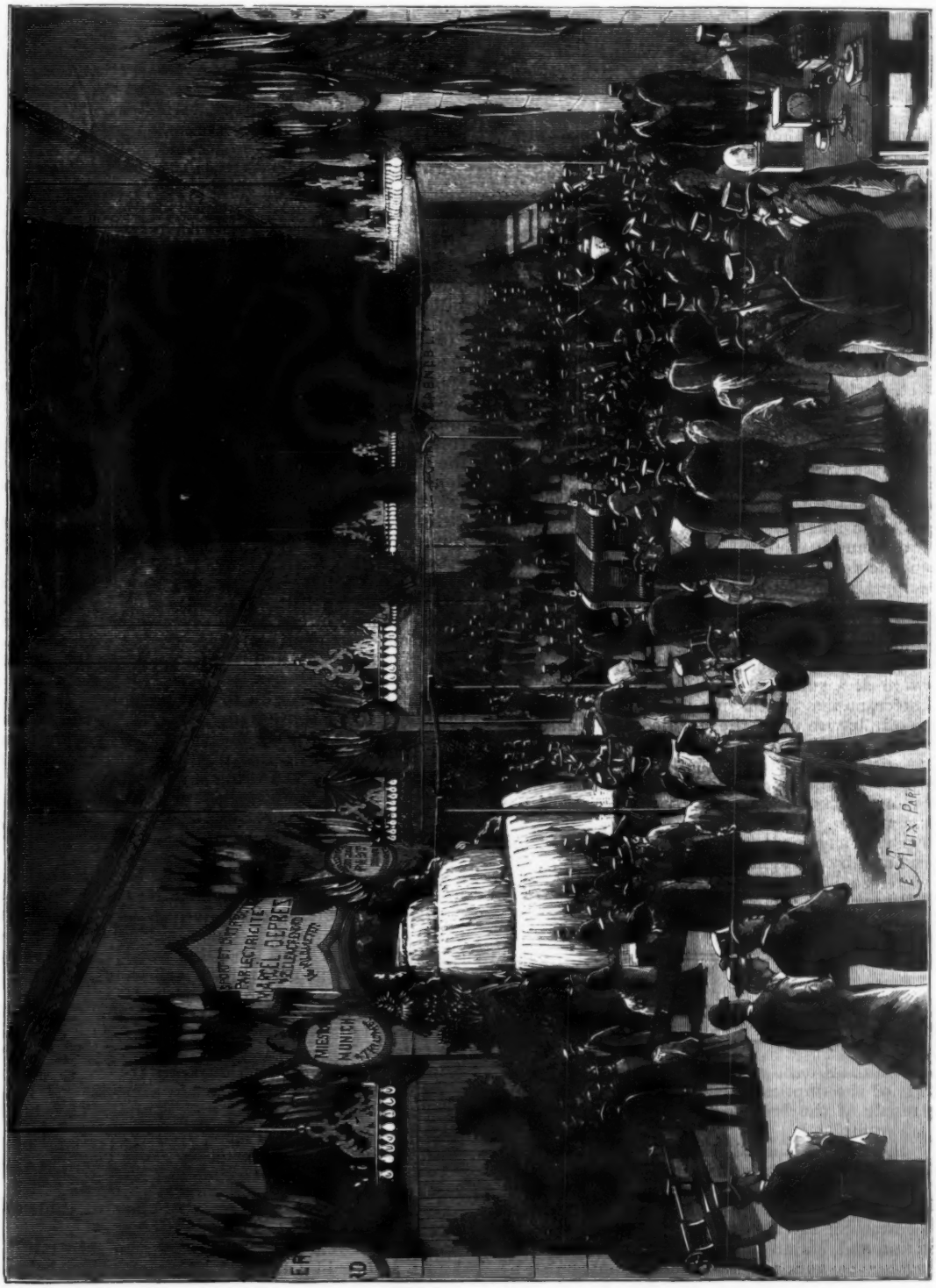


FIG. 21.—ASPECT OF THE HALL ILLUMINATED WITH THE ELECTRIC LIGHT.

is strengthened at the lower electrode to the right and weakened at the upper.

This method of producing Hall's phenomenon requires a stronger current in the plate than does the ordinary method, since the resistance of the galvanometer occurs in the circuit. But it has the great advantage of making the investigation possible even when plates of any substance can only be obtained of very small dimensions and of any irregular form.

The second result relates to Hall's phenomenon in bismuth, a metal in which it has not yet been demonstrated, doubtless on account of the difficulty of obtaining it in broad and thin plates. It was found practicable according to the method above described to show, by means of small irregular and very thin fragments of this metal, that Hall's phenomenon occurs in bismuth with remarkable intensity, and in the same direction as in gold. With an equal current a bismuth plate of 0·079 mm. in thickness gave deviations five to six times greater than did a gold plate of 0·000087 mm., *i.e.*, a thousand times thinner.

From a rough determination it appeared that the coefficient of deflection in bismuth is about 5,000 times that of gold.

I succeeded ultimately in obtaining sufficiently thin plates of bismuth in the shape of a cross, and thus in verifying the phenomenon by the ordinary method. The effect, both as to direction and intensity, was exactly what had been foreseen.

The results obtained with a small cross of bismuth, 0·017 mm. in thickness, 18 mm. in length, and 4 mm. in breadth, are very remarkable, for I succeeded in producing Hall's phenomenon, not alone by means of the ordinary powerful electro-magnet, but with an ordinary simple magnetised steel rod. With the current of a Bunsen element I obtained permanent galvanometric deviations of about half a metre on the scale, on applying either pole of a cylindrical magnet of 324 mm. in length and 14 mm. in thickness at a distance of 2 mm. from the bismuth. The distance from the mirror and the scale was 28·0 metres, and, as a matter of course, the magnet and the plate upon which it acts were at a sufficiently great distance from the galvanometer, so that the magnet might exert no direct perceptible influence upon the needle of the galvanometer. Even small magnetic needles applied to the plate gave distinct indications. I do not doubt, therefore, but that it will be practicable to produce Hall's phenomenon in bismuth simply by the action of the earth's magnetism.

With the arrangement with three electrodes the effect produced by a magnetic rod upon thin bismuth plates traversed by the current was very distinct.—*Exner's Repertorium der Physik.*

THE MADEIRA-ST. VINCENT CABLE.

WE notice in the *Monthly Correspondent* an account of the laying of the duplicate Madeira-St. Vincent cable, and the repair of the broken section between St. Vincent and Pernambuco.

The "Stow-away Special Correspondent" of our readable little contemporary gives the following narrative of the accomplishment of the above important work :—

The contractors for this work were the Telegraph Construction and Maintenance Company, and the ship employed for the work was the *Scotia*, commanded by Captain Cato, and the finest of the fleet of telegraph steamers belonging to the company.

The gross and nett tonnage of the *Scotia* are 4,666 and 2,935 tons respectively. She is fitted with twin screws with two separate engines of 2,300 total indicated horse-power, and is therefore, notwithstanding her great size and length (379 ft.) capable of being manœuvred about as required, a great *desideratum* for a cable ship. She contains three large cable-tanks of the following dimensions :—

No. 1.	36 ft.	in diameter	by	23 ft.	deep.
No. 2.	40 ft.	„	„	23 ft.	„
No. 3.	37 ft.	„	„	15 ft.	„

and carried on this occasion, with a comparatively small draught of water, 1,231 nautical miles of six different types of cable, weighing in all 2,020 tons. As compared with the former cable, the shore-ends and intermediate types of this new cable are considerably heavier, longer and of better construction than those of the original M.D. S.V. section, but the 1,900 knots of deep-sea cable is somewhat smaller and lighter but of greatly improved construction to the 1874 cable, and is likely to prove far more durable.

The ship left the Thames on the 10th of March, and after a very fine and rapid run down the channel, anchored about 11 a.m. the following morning at Weymouth, where at 4 p.m. she took on board the chairman of the company, Sir Daniel Gooch, Bart., also Lady Gooch, and Sir George Elliott, M.P., a director of the company and a member of the former firm of Glass, Elliott & Co., whose business was taken over by the Telegraph Construction Company.

At 7 a.m. on the 17th of March, after a very rough passage, the *Scotia* came to anchor off Funchal, Madeira, landed there Sir Daniel and Lady Gooch and Sir George Elliott—took in coals, and early the next morning moved into position about two cable lengths from the cable-house, and at once proceeded to land the shore-end of the new M.D. S.V. section. This was done under the immediate direction of Mr. Frank Lucas, the T.C. and M. Co.'s chief engineer of the expedition. A strong hawser was passed on shore to connect the ship with the landing-place, and there passed round a large sheave firmly attached to the rocks, and the end passed back to the ship, where it was then attached to the steam-winch. The cable end was then well lashed to the hawser, and by means of the steam-winch on board, as well as with the assistance of a few boats and some two dozen large wooden casks (the latter being temporarily secured at regular distances along the cable to be landed) was floated and thus hauled on shore with great ease, and in comparative silence, as the ship and shore staffs communicated with each other by means of different coloured flags.

This operation was witnessed from the deck of the ship by a small group of visitors from the shore, whilst others who preferred remaining on *terra firma* enjoyed a capital view of the landing of the cable from the rocks adjoining the cable-house.

After the visitors to the ship had been entertained at luncheon by Captain Cato, and after the engineers and electricians of the Brazilian Submarine Telegraph Company, and those of the contractors had satisfied themselves on shore that the cable was all right and the electrical arrangements were complete and working well, the ship was cleared of visitors, and at about 3 o'clock p.m. the *Scotia* got under weigh. The paying-out drum began to move round and to pay out cable towards St. Vincent, Cape de Verd Islands, this continuing without interruption until the drum indicator showed that the drum had made some 390,000 revolutions and that some 1,150 nautical miles of cable had been paid out, when the end was buoyed in about 600 fathoms, about a mile and a-half from the island of St. Antonio, Cape de Verd, at 5 p.m. on the 25th of March, just seven days and two hours after leaving Madeira, only leaving to complete some 20 knots of cable to lay out from St. Vincent to this position.

In this seven days two hours, the ship ran 1,026 knots and paid out 1,150 knots of cable, being an average per diem of 145 knots distance and 162 knots of cable, thus showing an evenly distributed amount of slack of a little under 12 per cent.

The weather was fine throughout, and one day's work was so like that of the others, that it would be useless to give a detailed account of each day's proceedings, so it suffices to say that no hitch or difficulty occurred during the whole time of paying out, but

nevertheless the paying out required the greatest possible attention of the engineers in charge, in order that the cable should not be paid out unduly tight or slack.

The required strains to be applied in the varying depths of water ranging from 1,000* to 2,700 fathoms were, previous to commencing operations, most carefully considered and calculated, and, by due attention to the same, most satisfactory results were obtained, as the slack per cent. varied very much in proportion to the depths passed over. The maximum amount of cable paid out in 24 hours was 172 knots, which was quite as fast as any cable should be laid, paying due regard to safety.

Having buoyed the cable end off St. Antonio (near St. Vincent), the next important operation to be attended to was the repair of the broken cable of the St. Vincent-Pernambuco section.

This was taken in hand so soon as the cable on board destined for the repair had been turned over and duly tested. This necessary work was completed just before noon of the 26th of March. Owing to the S.V. P.B. cable having been cut at about half a knot from the shore after having been under-run from the beach by the B.S.T. Co.'s St. Vincent superintendent, tests from the cable-house were rendered impossible. It was therefore considered best to grapple for the cable close to Bird Island lighthouse, where the two cables (S.V. M.D. and S.V. P.B.) were well apart. This was at once done, and the cable was on board in a very short time, and in a few hours 4½ knots of cable were picked up, when the broken end came on board, showing unmistakable signs of having been chafed through on the rocks. The depth of water at the break was 115 fathoms, and the distance from cable-house a little more than 5½ knots.

Several soundings of varying depths were taken in the neighbourhood of the break, and the bottom was found to be hard and rocky.

The picked up cable had now to be turned over and repaired, but further proceedings had to be deferred till the next day, when a short piece of cable between Bird Rock and the cut near the cable-house was picked up. The ship then went to the outer mark-buoy, picked up the Pernambuco end at about three-quarters of a mile from the end at the second dredge, when the splice was made, and 4½ knots of cable laid, which reached close up to Bird Island. The day being far spent, the completion of the repair had to be deferred till the next day, when a little before noon on the 28th of March, telegraphic communication with Pernambuco was re-established, and almost immediately after a considerable number of messages came pouring through from both sides, thus putting a valuable staff of telegraphists into active operation once more, the cable having been out of work for the space of 28 days.

The next morning (March 29th), at 6.15 a.m., the *Scotia* got into position about half a mile from the cable-house, and with the assistance of 36 empty casks and 12 shore boats, the heavy shore-end was landed in a similar manner to the Madeira shore-end, as already described; but owing to strong winds and tides, it did not prove such an easy operation, especially as the *Scotia* had to anchor in the neighbourhood of two other shore-ends, and could not, on account of her great length and draught of water, put herself into the best position for that purpose. This operation was completed by about 11 a.m., but the wind having greatly increased, it was deemed advisable not to proceed with the laying; consequently the ship lay at anchor with the cable at her bows until the next morning, when, the weather having become finer, a start was made about 10 o'clock, so soon as the ship swung in the right direction. A length of 16 miles of cable was paid out over the bows, and the buoy on the Madeira end was reached at about 3 p.m. In attempting to raise the cable end, the buoy rope to which it was attached seemed to catch on a rock on the bottom and parted in about 550 fathoms. Mr. Lucas at once decided to pay out the St. Vincent end into deeper water with a view to finding a softer bottom and more favourable grappling ground. When 18 miles had been paid out, a sounding gave 735 fathoms, ground consisting of mud and sand, and soon after the cable end was buoyed up near the surface in about 780 fathoms. It was then near sun-down, so the ship steamed on and off a course during the night, and at day-break on the 31st of March proceeded to a position and grappled for the cable and caught it on the first dredge, and this time raised the bight to the surface under very considerable strain. This was then buoyed in a similar manner to that of yesterday, when yesterday's buoyed end was got on board, and with a further expenditure of a little more than a mile-and-a-half of cable, the *final splice* was made with the new Madeira end in about 1000 fathoms of water, thus completing the duplicate Madeira-St. Vincent section.

This operation was concluded before 6 p.m., when the mark buoy was picked up, and the *Scotia* anchored in St. Vincent Harbour at about 9 p.m. The total length of the new cable is 1168·22 knots, the former cable being 1,197 knots in length.

April the 1st was devoted to taking official tests of the new cable, and also in testing the repaired Pernambuco section, as well as in seeing the four subterranean lead-covered land-lines duly laid in the three foot trench, about half a nautical mile in length, between the cable-house and the station.

At 9 p.m. all were on board, and the *Scotia* got under weigh for Madeira, where she arrived on Saturday, the 5th of April, at 4.30 p.m., thus making an exceptionally rapid passage.

Mr. Henry C. Forde, of the firm of Clarke, Forde and Taylor, accompanied the expedition as chief engineer to the Brazilian Submarine Telegraph Company, and he was assisted by Mr. Frank Lambert, the principal assistant of the firm, and by Mr. T. W. Bacon.

The *Scotia*, in company with the *Calabria*, is expected to return in a short time to St. Vincent with the new duplicate cable to be laid between that place and Pernambuco.

* 1000 fathoms = 1 mile odd, 2,700 fathoms = 3 miles odd.

NOTES.

Electric Lighting.—The Electric Lighting (Provisional Order) Bill was read a third time in the House of Commons on Thursday week, and passed.

The arrangements for the electric lighting of the International Forestry Exhibition about to be held at Edinburgh were before the committee last week. In the ground rented from Heriot's Hospital will be placed all the machinery in motion, the necessary engines for driving the machines and for the electric railway and lighting.

It is said that connection has been established, and is in working order, between the Edison electric light station in New York and over 500 houses in that city, with wires fixed for some 13,000 lamps. Says the *Evening News*, "The almost threadbare question recurs to us, 'Why should London wait?'"

The Commissioner for Public Works for Victoria has called for tenders for lighting the Parliament Houses with electricity. It was intended to light almost every department in the building.

The *Colonies and India* states that the Electric Light Company at Kimberley has made an offer of its plant to the municipality.

The installation of the Gülcher Electric Light Company, Limited, at the Crystal Palace, is now working successfully, and effectually lights the central nave. The installation consists of 75 arc lamps of 2,000 candle-power (nominal) each, connected in multiple arc, and fed by the current from three Gülcher dynamos, No. 5 type, running at 500 revolutions per minute. There are four dynamo machines, connected parallel, and so

arranged that the difference of potential at the terminals of each machine is kept constant. Provision is also made for the switching-off of any one working machine, the spare machine being substituted without stopping the light. The current generated is led in a pair of main wires to a switch-board, where it is divided into the necessary number of circuits, each circuit at this point being provided with a fusible plug. Arrangements are made at the switch-board for measuring the current without disturbing the light. About 80 horse-power is said to be absorbed. The lamps are suspended by the cable which carries the current, and are provided with counter weights to facilitate the raising and lowering of them. There are 54 lamps in the great nave, 12 in the orchestra, and 8 in the opposite transept. The lamps require 8 ampères each, and a terminal potential of from 65 to 70 volts is maintained at the machines. The lighting is under the direction of Mr. Guy C. Fricker, the company's electrician, who is to be congratulated upon the success which has attended his efforts. The lamps burn very steadily, and the illumination of the various objects of interest on view in connection with the International Exhibition now proceeding is effective and complete. We hear that the Crystal Palace Company has it in contemplation to extend the use of the electric light to the whole of the courts and galleries at the Palace, so satisfied are they with their arrangements with the Gülcher Company.

In the House of Lords, on Tuesday, the Earl of Milltown asked why the electric light, which had long since been successfully introduced into the House of Commons, had not been introduced into that House, and whether it was intended so to introduce it, and, if so, when? He complained that a vote had been granted for the purpose of introducing the electric light into both Houses, but, while the House of Commons had taken care of themselves, the House of Lords was left with an illuminant which had almost gone out of fashion for public buildings. Lord Sudeley: In reply to the noble earl, I have to state that the First Commissioner of Works has the whole question of lighting in the Houses of Parliament with the electric light now under consideration. Plans and estimates are being made out, and it is intended, if possible, to light up with the electric light, not only the library, corridors, and lobbies, as has been done in connection with the House of Commons, but also, in this case, to light up the interior of the House of Lords itself. The noble earl has referred to the fact that last year a small vote was taken to light up the library. This was undoubtedly true, but when the First Commissioner came to go further into the matter, he found that owing to the very short time your lordships sit in the evening, it would be most uneconomical to light up only so small an area, and that it would be better to wait until it would be possible to light up all the lobbies and the House itself as well as the library. The Earl of Longford: Does the noble lord mean that we must wait 12 months for the electric light? Lord Sudeley: I endeavoured to explain that there will be no difficulty when it is found possible to light up the whole area, and not only a limited area such as the library.

The Lighting Committee of the Eastbourne Town Council, having received a letter from the Eastbourne Electric Light Company, making certain suggestions relative to the extension of the electric light to the new western parade, and requesting the committee to meet a deputation from the directors, decided that it was premature to take into consideration the lighting of the western parade at present.

We learn from an American exchange that the Toronto Electric Light Company, Limited, has had 55 lights in operation since September 14th, 1883. They have purchased a building three stories in height, 96 × 40, which when completed this month will be one of the finest electric light stations on the Continent. The outfit will consist of three steel boilers, 6 × 15, each 100-horse power capacity, with six high speed engines, enabling the company to run 300 arc lights. As soon as the arc light system is completed the company will develop the Hochhausen incandescent system to be run from the arc circuit or from an independent circuit. The company has been experimenting with the incandescent system for some time, and now feel that it is so perfect as to give the greatest satisfaction. With the Hochhausen system, Toronto stands a good chance of being most brilliantly lighted, even if no other method is tried there.

The electric light fittings for the Royal Pavilion in the Health Exhibition have been supplied by Messrs. Faraday & Son, of Berners Street. These are fitted with Edmund's new patent locking holder, to facilitate the changing of the lamps when necessary. The same firm has also supplied fittings for 300 lamps for the dining and smoking rooms, in the western wing of the conservatory.

Messrs. Faraday & Son, of Berners Street, W., have lately been engaged upon some special electric light fittings for one of the Cambridge Colleges, and for the Royal Hotel, London.

The managers of the Metropolitan Asylums Board invite plans, specifications, and estimates for lighting, and the annual expense of keeping lighted by electricity the three hospital ships and station on shore at Long Reach, near Gravesend. In the case of the ships the machinery must be on shore, or at least so placed as not to disturb the patients or officers.

The International Electrical Conference.—The conference for fixing an International system of electrical units met in Paris on Monday, the 28th ultimo. It may be remembered that the first meeting was held in October, 1882, and adjourned in order to give time for further experiments to be made. The following countries all sent delegates to the meeting: Austria, Argentine Republic, Belgium, China, Costa Rica, Columbia, England, France, Germany, Holland, Guatamala, Italy, Japan, Mexico, Nicaragua, Persia, Portugal, Roumania, Russia, Salvador, Sweden and Norway, Switzerland, and the United States of America, making in all a total of some 53 members. England was represented by the following delegates, named by the Government: Sir William Thomson, F.R.S.; Professor Carey Foster, F.R.S.; Professor Fleeming Jenkin, F.R.S.; Professor Hughes, F.R.S.; Mr. Graves, chief engineer Post Office telegraphs; Mr. W. H. Preece, F.R.S., chief electrician Post Office telegraphs; Captain Abney, R.E., F.R.S.; Professor W. G. Adams, F.R.S.; and Mr. J. Aylmer, C.E., the latter also acting as the hon. secretary to the British delegates. The meeting was held at the Ministry of Foreign Affairs, M. Jules Ferry, President of Council of Ministers, and Minister of Foreign Affairs, presiding, and making the opening speech, in which he expressed the gratification felt by France in again welcoming the men of science sent by all countries to the conference. He referred to those members who had died since the last meeting: Sir W. Siemens, of England; Captain Hoffmeyer, of Denmark; and more especially Monsieur J. B. Dumas, of France; and finished a most effective discourse with the following words: "Happily, gentlemen, science is immortal, its light passes from hand to hand and never goes out. Inheritors of the researches of those great men who have gone before you, you gather in the fruit of their labour, and in your turn enlarge the domain of their peaceful conquests. This is, gentlemen, your special and enviable privilege, for while all the other works of man, in public as well as in private life, have only a short duration, and only fulfil a transitory office you alone are engaged on a permanent work, on the only human labour which never perishes, and which never ceases to extend." The active presidency of the conference was voted to M. Cochery, Minister of Posts and Telegraphs, and three commissions were then formed, one for examining the question of electrical units, one for that of earth currents and lightning protectors, and one for fixing a unit of light. Several meetings of these commissions, and also of the full conference, were held, at which most interesting discussions took place upon the various

subjects submitted for examination. The following resolutions were unanimously adopted :—

1. *Electrical units properly so called.*—Resolutions. 1. The legal ohm is the resistance of a column of mercury a square millimetre in section and 106 centimetres long at the temperature of melting ice. 2. The Conference expresses the desire that the French Government will transmit this resolution to the various countries, and recommends its international adoption. 3. The Conference recommends the construction of primary mercury standards in conformity to the resolution previously adopted, and concurrently the employment of secondary scales of resistance, made of solid metal alloy, which shall be frequently compared with each other and with the primary standard. 4. The ampère is the current of which the absolute measurement is 10^{-1} in electro-magnetic units. 5. The volt is the electromotive force which maintains a current of one ampère in a conductor whose resistance is the legal ohm.

2. *Earth currents and lightning conductors.*—Resolutions. 1. It is desirable that the results of observations obtained by various Administrations be sent each year to the Bureau International des Administrations Télégraphiques à Berne, who will make a copy, and communicate it to the Governments. 2. The Conference expressed the desire that observations of earth currents be pursued in every country.

3. *Standard of light.*—Resolution: The unit of each simple light is the quantity of light of the same kind emitted in the normal direction by a square centimetre of surface of molten platinum at the temperature of solidification. The practical unit of white light is the quantity of light emitted normally by the same source.

The final meeting of the conference was held on Saturday last, when, after a speech from Monsieur Cochery, congratulating them upon the rapid and successful results of their labours, and thanking them for their attendance, the members separated.

An Extraordinary Suit.—In the Queen's Bench Division, London, on Saturday, the case of Hind *v.* Russell and others was heard. This was an action brought against Mr. Charles Russell, Q.C., and other barristers, including the Attorney-General, and also against several solicitors and other gentlemen. The plaintiff alleged that he and Mr. Allan had established the United Kingdom Electric Telegraph Company, and he claimed £100,000 as damages in respect of injustice which he suffered in connection with the affair. Mr. Justice Butt had made an order dismissing the action so far as the Attorney-General was concerned, and this order was now appealed against. Mr. Justice Grove said that the rule relied on by the plaintiff did not mean that the Attorney-General could be made a party to every proceeding where it was alleged that injustice had been done, but only in cases where the honour or dignity of the Crown was concerned. The appeal was dismissed with costs.

A Mill Struck by Lightning.—During the height of a heavy storm last week, the lightning cut down the flag-staff over Holyrood Mill, Oldham, and then entered the roof of the mill, creating a large aperture. It struck one of the spinning mules in the top room, and set some of the cotton in process on fire. The room was soon a mass of flames. With some difficulty the flames were subdued, but not before damage to the extent of several hundred pounds was done.

Reports from various parts of the country show thunder storms to have been very frequent towards the end of the last and the beginning of the present week.

A thunderstorm of great violence burst over London on Monday; balls of fire are reported to have fallen, and telegraph wires in Blackfriars Road were fused by the electric fluid and fell.

Personal.—Mr. Jerome Carty has arrived in London on behalf of the International Electrical Exhibition, to be held at Philadelphia this year under the auspices of the Franklin Institute. This gentleman, who is staying at the 1st Avenue Hotel, will be glad to furnish any information desired, or send printed circular by mail to those of our subscribers who may be interested in the subject.

Glasgow Philosophical Society.—At the last ordinary meeting of the Glasgow Philosophical Society, held last week, a paper was read by Professor Blyth on a new form of galvanometer and voltmeter. The instrument consists essentially of a closed coil of insulated wire, bent into a circular form, so as to constitute an endless solenoid. The current to be measured passes through the solenoid and deflects a short magnet, suspended or pivoted so as to have its centre in the circular centre line of the solenoid, the deflections of the needle being observed by a suitably-placed pointer. Two advantages of the instrument were pointed out. One is that the constant of the instrument admits of easy determination, seeing that it depends only on the radius of the circular centre line and the number of convolutions of wire; the other is that the endless solenoid constitutes a closed magnetic shell, and in consequence can exert no magnetic force at any point outside itself. In this way the current in the act of being measured has no tendency to disturb the magnetism of any controlling magnet that may be used, or to alter in any way the elasticity of any steel spring that may be employed to counterbalance the deflection of the magnetometer needle. In one of the instruments exhibited the balance spring of a watch was used to act on the magnetometer needle, and an arrangement was provided whereby the spring could be coiled up to any required extent, so as to allow either strong or weak currents to be measured. Professor Blyth also explained his method of graduating the new instrument, and showed how the solenoid galvanometer he had previously invented could be used for that purpose. Professor Jamieson congratulated Professor Blyth on the beauty and utility of his invention. He had no doubt it would be useful, not only as a standard instrument, but as a practical instrument, which might be put into the hands of electricians when going about their work. The thanks of the society were given to Professor Blyth for his paper. Mr. Alexander Pinkerton next read a paper descriptive of an apparatus for the total consumption of smoke in boiler furnaces. In the course of the discussion which followed, several gentlemen testified to the efficiency and economy of Mr. Pinkerton's apparatus. Professor M'Kendrick afterwards read a sketch of the life and work of the late Professor Allen Thomson, who was, he stated, for 35 years a member of the Philosophical Society and at one time its president. On the motion of the chairman, a cordial vote of thanks was passed to Dr. M'Kendrick for his interesting, eloquent, and touching memoir. Dr. Muirhead was appointed delegate from the society to the meeting of the British Association, to be held in Montreal in autumn; and it was further agreed that Mr. Mactear should go as second delegate, provided that this was in accordance with the regulations of the association. The meeting then separated.

Dispute between Electrical Engineers.—Vice-Chancellor Bacon on Friday week, in the London Chancery Division, on the application of Mr. Marten, Q.C., declined to grant an injunction restraining William M'Whirter from carrying on the business of an electrical engineer within 50 miles of Barrow or Glasgow, in alleged breach of an agreement between himself and Messrs. Musgrove, who carry on business as electrical engineers at Glasgow and Barrow-in-Furness, and ordered the matter to stand until the trial.

Action for Breach of Contract.—Before Mr. Justice Kay, on Saturday, an action was brought by W. Muir and Company, machinists and engineers, of Manchester, against the Anglo-American Brush Electric Light Corporation to recover damages for breach of contract in respect of certain machinery which had been ordered by the Defendants, but which when completed they refused to receive on the ground that it had not been

made and delivered within the time specified in the contract. The Plaintiffs alleged that no specific time was agreed upon as to the delivery of the machinery, and that they were expressly told that there was no hurry for it. They, however, undertook to do their best to deliver the goods as soon as possible, and this they asserted they did. The case was tried at the Manchester Assizes last year, and on that occasion the jury being unable to agree, the judge (Mr. Justice Butt) directed a verdict for the defendants on a point of law. The case went to the Court of Appeal, and the presiding judge there decided that there was no point of law for decision, and that the question, which was one for a jury, was whether the machinery had been delivered as early as possible. The Court therefore directed a new trial upon that point. Counsel having detailed the facts as stated, a number of witnesses were called upon both sides as to the point whether the machinery, which was for the purpose of making dynamo machines, and was to cost about £730, had been made within reasonable time. The hearing was adjourned till Monday, when the jury found for the plaintiffs for the full amount agreed upon (£736), the machinery to be delivered to the defendants. Judgment was entered, but on the application of Mr. Gully his lordship ordered stay of execution.

An Electric Mountain Railway.—"A project has been formed," writes a correspondent of the *Times*, "and will, in all probability, shortly be executed for uniting the Hotel des Alpes, at Territet Chillon, and the Hotel de Mont Fleury, which is situated on the steep mountain side immediately above Chillon, by an electric railway. The difference of altitude between the two hotels is 180 metres, and a few days ago the system which it is proposed to adopt was put to an experimental test. Rails of a gauge of 50 centimetres were laid on a part of the mountain for a length of 50 metres, and with a gradient of 30 in 100. Between the rail is a rack for the reception of a toothed wheel, and at each end is a curve in order to show the advantage of the proposed system. The waggon carries a dynamo-electric machine, which actuates by special gearing a toothed wheel on the axle in connection with the rack between the rails. An electric and an ordinary brake enable the conductor to modify the rapidity of descent at pleasure. The electricity was produced for the occasion, and in the first instance, by a dynamo-electric machine of five-horse power, actuated by a portable engine. This engine it is intended to replace eventually by a turbine, for which there is an ample supply of water. The apparatus for the transmission of the electric force to the receiver on the waggon consists of copper cables laid between the rails and alongside the rack, and the electric contact is established through the intermediary of mechanical brushes in the usual way. The carriage, in which were seated two, three, and sometimes four persons, the whole, including the carriage, representing a weight of from 300 to 500 kilogrammes, went up the steep incline at the rate of from 1 metre to 2 metres per second, and the descent was completely controlled by the ingenious combination of the two brakes. In the event of the project being carried into effect, which depends to some extent on the approval of the Federal Government, the journey between the two hotels may be performed in seven or eight minutes. As, moreover, water is plentiful in Switzerland, there is no reason why every fashionable mountain should not have its own particular electric railway, and the time may come when idle or infirm tourists will ride luxuriously across the Mer de Glace, and be carried on wheels half way up the Jungfrau and the Matterhorn. Already the people at Geneva, encouraged by the success of the experiment at Territet Chillon (Montreux), are proposing to utilise the waters of the Arve for the ascent of the Salève. But what will Mr. Ruskin say?"

J. B. Rogers's Electric Light and Power Company, Limited.—Vice-Chancellor Bacon on Saturday made an order for compulsory winding-up on the petition of Messrs. W. T. Glover and Co., creditors of the company. The company's property was in the possession of a receiver. Mr. Swinfen Eady appeared for the petitioner; Mr. Grosvenor Woods for the company did not oppose; Mr. Millar, Q.C., Mr. Druce, Mr. E. C. Thomas, and Mr. Biddall appeared for judgment creditors.

Bleaching by Electricity.—Bleaching by electricity has made little progress since it was introduced by Messrs. Goppelsroeder and Dobbie, nor do we expect to hear much of it in the future. M. Goppelsroeder, however, appear to be anxious to introduce electricity into the dyehouse, and has been experimenting with a view to reduce indigo by its aid. In a communication to the Mulhouse Society he reports that by causing a current of electricity to pass through a caustic potash solution containing indigo held in suspension in a copper vessel, the same enclosing a porous cylinder containing a solution of a similar kind, he so reduced the indigo that he could dye cotton with it.—*The Dyer*.

Tenders Invited.—The Caledonian Railway Company invite tenders to be lodged with their secretary, at 302, Buchanan Street, Glasgow, not later than the 19th inst., for India rubber, galvanised iron wire and strand, telegraph instruments, &c. The Glasgow and South Western Railway Company are open to receive tenders for similar stores up to Monday next.

The Position of Telegraph Clerks.—Sir Herbert Maxwell, in the House of Commons last week, asked the Postmaster-General whether he will consider the propriety of extending to those telegraph clerks whose services were transferred from the companies to the department, and who (having not less than 25 years' service) have not received promotion consequent on the last revision, the same benefits conferred upon those whose appointments were abolished at the transfer, namely, retirement upon a pension of two-thirds of their present salary; and, if not, whether he is prepared to consider any means by which their position may be improved. Mr. Fawcett said that the telegraphists referred to by the hon. baronet came under the Superannuation Act of 1859. They would not be entitled to retire on two-thirds of their salary, or on any portion of their salary, unless in case of sickness or if their offices were to be abolished. He need hardly say that there was no intention of doing this. They, in common with others, had lately had their prospects considerably improved by a recent revision of the scheme which involved a large additional charge upon the revenue. He did not feel that he would be justified in holding out any hope that the question would be re-opened.

The Recent interruption of Telegraphic Communication at Glasgow.—The Glasgow magistrates having complained to the Postmaster-General of the recent interruption of telegraphic communication, have been informed "that the question of interruptions of telegraphic communication has been frequently under consideration; that these have not occurred in any particular locality, but in various parts of the country; that the placing of one section of the lines under ground would not, therefore, ensure immunity from interruption, while the cost of substituting underground wires throughout the kingdom, or even between the principal towns, precludes its adoption."

Telegraphic Communication with Orkney and Shetland.—Mr. Tulloch and Mr. Jamieson, speaking at a meeting of the Aberdeen Chamber of Commerce on Saturday last, urged that the telegraphic extension in Orkney and Shetland should be completed before the herring fishing season this year.

Telegraphic Extension to the Islands of Scotland.—The Marquis of Lorne last week, at an interview with delegates from the Island of Coll and another, said he would use his influence with the postal authorities to obtain an extension of the telegraph to their islands,

and the establishment of a better service of mail steamers.

Extension of the Telegraph in Orkney.—At a public meeting held at St. Margaret's Hope, Island of South Ronaldshay, relative to the extension of the telegraph to South Ronaldshay, including the fishing stations at Holm and Burray Island, Mr. William Cromarty presiding, Mr. W. T. Norquay, banker, made a statement regarding the negotiations with the Postmaster-General and the Fishery Board. The Fishery Board had intimated their willingness to guarantee two-thirds of the sum required, and the guarantee had been reduced to £298. Mr. Laughton, merchant, undertook in the first place to guarantee the amount required, as the time was limited for reply. The subject was entered into very heartily by the proprietors, merchants, farmers, fish-curers and fishermen, and the full guarantee was subscribed, to be available if required. It is hoped the extension will be effected in time for the herring fishing, which commences in June. Last year severe losses were sustained through the fishermen being unable to learn when fish were plentiful at one station and scarce at another.

Telegraph Extension to Barra.—Instructions have, says the London correspondent of the *Scotsman*, been given for a start being at once made with the works for the extension of the telegraph to Barra. The Treasury has authorised the Fishery Board to give the necessary guarantee, and the Board has, in turn, requested the Postmaster-General to give instructions for the extension being at once carried out, in the hope that the telegraph may be available during the approaching fishing season. The Treasury has undertaken to provide a vote of £500 for the next two or three years, and Lady Cathcart and others interested in the locality will guarantee two-thirds of the balance of the £1,095 guarantee required by the Post Office.

Cable from Senegal to Canary Islands.—According to a telegram from Paris, the convention between France and Spain for the laying of the cable between the Canary Islands and Senegal was signed on Friday, the 2nd inst., by M. Ferry and Senor Silvela the Spanish Ambassador.

Cable News.—The cable between Ceylon and India, which has so often got out of order, and was only a few months ago the subject of a deputation to the Governor of Ceylon, has again got damaged, the *Colonies and India* states, and messages are at present being conveyed across the Paumben Channel by the Colombo harbour tug *Active*, the Indian Government having telegraphed to the Colombo Postmaster-General asking for her services to aid in picking up the damaged cable. It is fortunate that the sea was calm in the Paumben Channel, otherwise much delay and trouble would have been experienced in the repairing.

The Post Office and Telephones.—In answer to Mr. Gray in the House of Commons, on Thursday, the 1st inst., Mr. Fawcett said: I think it would not be possible, without describing in detail the policy of the Post Office with regard to telephone licences, to give a full answer to all the questions which have been addressed to me by the hon. member, and it is less necessary that I should do so in view of the notice he has given of raising a debate on the entire subject when the telegraph estimates are considered. I may say, however, that the licence which was granted to the Northern District Telephone Company was in every respect the same as that which it was decided to grant after the conclusion was come to nearly two years ago to allow any responsible persons, on conditions which were considered necessary in the interests of the public, to obtain a telephone licence. I was aware of the general nature of the relations existing between the United Telephone Company and the Northern District Telephone Company at the time the licence was granted to the latter company for Newcastle; and it was, in my opinion, for the Northern District Company, who were in intimate relations with the United Telephone Company, to consider how they could carry out the stipulation which they agreed to accept. There has been no occasion hitherto for the department to call upon the company to fulfil the condition of supplying telephones which they are using, but I do not think it would be expedient for me to give any assurance which might fetter the action which in future it might be in the interests of the public desirable for the department to take with regard to obtaining a supply of telephones and the manner in which they should be used.

In answer to Mr. Gorst, who asked a question for Sir H. Wolff, on Monday, Mr. Fawcett said: The Post Office on the 31st of March last had 783 subscribers to its systems of telephone exchanges for rentals, amounting to £16,983 per annum. As it would take much time to ascertain what the number of private wires rented from the Post-Office which are worked by telegraph and telephone apparatus respectively, I am sorry I am not able to answer the hon. member's second question. If the telephone exchange lines of the department were provided by the private telephone companies at the same rentals, the royalty payable would be £1,698 per annum. No royalty is payable to the Post Office in respect of private wires—*i.e.*, wires used for private messages, as defined by the Act of 1869, erected and maintained by persons outside the department. So far, therefore, as this business might be done by private individuals, no revenue would be received by the Post Office. In answer to Dr. Cameron, Mr. Fawcett said: The amount of royalties received by the Post Office in the year ended 31st December last, from telephone companies for licences to carry on business which has been legally decided to be telegraphic, was £15,556. The original rate of percentage was 10 per cent., increased in a few cases of extension of radius. In reply to my hon. friend's last question, I may say that in new licenses the percentage is no greater, but a *minimum* royalty of £1 is payable.

An Army Telegraph Corps.—Col. Du Plat Taylor having now obtained the sanction of the Secretary of State for War and the Postmaster-General for the formation from the members of the Post Office Volunteers, of a corps of 50 telegraph clerks for service with the army, has received applications from more than double that number of volunteers, and steps will at once be taken for organising this corps. The men will enlist for six years and be placed in the first class Army Reserve, available for service in the field with the army when required.

An Industrial Use for Electricity.—M. Henri de Parville calls the attention of wine growers to the services electricity might render them in protecting their vines from the disastrous effects caused by a sudden fall in the temperature. For several years past vines in France have been protected from the effects of cold winds or sudden changes in the temperature by artificial clouds of smoke, produced by the burning of tarred straw and other combustibles. Vine growers have learned to appreciate the benefits of this system, but to light the fires at the right moment in the night-time, it is indispensable to have a thoroughly reliable watcher. By the aid of electricity the safety of the vines would be ensured. A vine grower has only to place in his vineyard one or more electric batteries similar to those used to fire mines, the wires being connected with the fires prepared at regular distances. When the thermometer falls towards zero, by means of a very simple arrangement, it causes the electric current to pass along the wires, the fires are lighted, the air being filled with the protecting smoke clouds. M. de Parville cites one or two instances in which his system has been most successfully employed, with very little outlay to the vine grower.

Fire Prevention.—It is now generally acknowledged that public or private buildings are in little danger of taking fire when the electric light, under skilled supervision, is installed as the illuminant. This comparative

immunity from the destructive ravages of this dread element may be still further increased, for Captain Shaw, the well known chief of the London Fire Brigade, makes the following comments on the Cyanite paint, of the company bearing the same name : "I have no doubt that your Cyanite would be found most useful in preventing the spread of fire, and I should be glad to see it more generally used on wood, canvas, and other materials in theatres, public buildings, and private houses. I consider that wooden stairs coated with Cyanite are, in case of fire, much safer than stone."

The Health Exhibition, South Kensington.—Previous to the opening ceremony on Thursday last, the officials of the Exhibition and members of the press met at breakfast in the south dining-rooms, at which the Duke of Buckingham and Chandos presided. His Grace stated that any information or assistance he could render he would be pleased to give, and he then proceeded to show the members of the press through the various portions of the building, calling attention to the industrial exhibits of the water companies, baking processes, and the beautiful productions of the Buckingham pillow-lace makers. Soon after noon the Grand Duchess of Mecklenburg-Strelitz and Lady Mary Grenville took their seats on the dais upon the arrival of H.R.H. the Duke of Cambridge, representing H.R.H. the Prince of Wales ; Mr. Gladstone, Lord Granville, Sir Vernon Harcourt and others being on the platform. An address was delivered by his Grace the Duke of Buckingham, and after H.R.H. the Duke of Cambridge had replied, the Exhibition was declared open. We observe that the electric lighting exhibits are progressing satisfactorily towards completion, the whole of Wednesday night being occupied in forwarding the various installations.

War Telegrams and the Press.—After a protracted hearing, the action brought by the Central News, Limited, against the Eastern Telegraph Company, the Exchange Telegraph Company, and others, terminated on Wednesday. It was an action by the Central News against the Eastern Telegraph Company and Sir James Anderson, its manager, the Exchange Telegraph Company, of which also Sir James Anderson was at the time a director, and Mr. Benjamin Smith, chief officer of the latter company at Alexandria, for diverting and divulging a telegram of the victory of Tel-el-Kebir, and sending it first to the Exchange Telegraph Company, a rival of the Central News. The case for the plaintiffs was that, there being a regular practice at Alexandria of the Eastern Telegraph Company's officers intercepting important telegrams of news and sending the effect of them first to Sir James Anderson to be used for his purposes, that course was pursued on this occasion, and the telegram of the victory of Tel-el-Kebir, sent by Mr. Burleigh, the Central News correspondent, who had personally witnessed the attack and capture, and had been to great exertion to dispatch the first intelligence thereof to England, was stopped at Alexandria by Mr. Smith, the manager there, and an abstract of its contents forwarded to London, where, on its arrival, it was at once sent on to the Exchange Company, who thus had it an hour before the Central News. The plaintiffs further complained generally that the defendants wrongfully published the contents of telegrams of news sent during the war by their correspondents before they, the Central News, had made them public, by reason of which they had, to a great extent, lost the use and value of the telegrams, and the services of their correspondents. The defendants denied the case thus stated, and in "further answer" thereto, the Exchange Company stated that if (which they denied) any of the plaintiffs' telegrams were divulged to them or their servants, or were published by them, they were so after the plaintiffs had made the contents public ; and further, that if any telegrams had been divulged or published it had been under these circumstances—that at the time referred to the English Government was engaged in military operations in Egypt, and all telegrams sent from the seat of war were required by them to be submitted to censors appointed for that purpose, and only telegrams passed by the censors were permitted to be sent, and the censors had power to alter or modify, and to send telegrams in such manner and to such persons as they thought fit, and all persons sending telegrams sent them upon the terms that the censor might so deal with them ; and that if any of the telegrams were divulged or published by the defendants' servants they were so in consequence of the censors divulging them to the defendants, and dealing with the telegrams as they were authorised to do, the defendants being not aware that the contents of the telegrams belonged to the plaintiffs, nor did they so belong. The Eastern Telegraph Company and Sir J. Anderson and Mr. Smith made this further defence :— They first stated that Sir J. Anderson was not managing director of the Exchange Telegraph Company (but it was now stated that he was a director of that company at the time in question, though he had since ceased to be so), and that he is managing director of the Eastern Telegraph Company, and then they went on to state that the telegrams mentioned were received by the Eastern Telegraph Company in the ordinary course of business, and that neither the company nor any of the defendants had published or divulged the contents thereof, or allowed them to be published or divulged, either to the Exchange Company, or otherwise ; nor had negligently or otherwise allowed that company or its officers or servants to obtain access to the contents thereof ; and they denied that they published the contents of telegrams of news sent during the war by the correspondents of the Central News, or had conspired to do so. Mr. Murphy, Q.C., Mr. H. Dickens, and Mr. A. M. Sullivan were for the plaintiffs, the Central News Company ; the Attorney-General, Mr. Charles Russell, Q.C., and Mr. Moulton were for the Eastern Telegraph Company, and for Sir J. Anderson and Mr. B. Smith ; the Solicitor-General, Mr. Bompas, Q.C., and Mr. Jeune were for the Exchange Telegraph Company. The case came before the Lord Chief Justice and a special jury on Saturday, April 26th, when Mr. Murphy opened the case for the plaintiffs at great length, and subsequently witnesses were called to detail the circumstances of the despatch of the telegram, its delay, and its non-arrival at the offices of the Central News until its contents had been published by the Exchange Company. Evidence was also given by clerks in the employment of the Eastern Telegraph Company, to the effect that Mr. Gibbs and Mr. Gillespy, whilst respectively manager and superintendent in the employ of the company, acted as correspondents of the Exchange Company, they having opportunities of reading the telegrams of the correspondents of other agencies ; and that on the arrival of the Burleigh message on the telegraph ship *Chiltern*, outside Alexandria, Mr. Smith copied it, and subsequently "cleared the line" and sent on a service message containing a short description of the battle of Tel-el-Kebir. The Attorney-General, having addressed the jury for the defence, Sir Charles Wilson was called, and stated that he was at Alexandria at the time of the fall of Tel-el-Kebir on a confidential mission, attached to Sir E. Malet. Among other things, it was his duty to communicate with him from time to time on matters of importance to the Government. Having heard of the victory from a half-bred native and others, and having subsequently read Mr. Burleigh's message, he despatched a telegram containing the intelligence to Sir E. Malet. Mr. Smith, in giving evidence, said under all circumstances it was his duty to look at messages which passed through the ship *Chiltern*, and he took the service message which he sent from the Wilson-Malet message only, but he could not say whether before sending off the service message he had seen the Burleigh message, which he had no recollection of. The news conveyed in Sir C. Wilson's telegram was publicly posted at Alexandria. Sir James Anderson, in his examination, said he never had messages sent to him anticipating Press messages, so that he might make use of them. He was in Scotland at the period under notice, and on his return did not interfere

in the matter. There was no truth in the statement that he had used news for Stock Exchange purposes. He had a son a member of the Stock Exchange, but had never given him information for such purposes. He was then asked as to other telegraph companies of which he was a director, and he replied that he was connected with nearly all. The telegraph companies, he said, "worked in" with each other, and must do so to succeed. Occasionally, he said, he had dealt in Stock Exchange securities; he could not say to what amount; it might be £20,000 a year; he would not say £40,000; he would not go beyond £20,000. He did not call that dealing "largely" in Stock Exchange securities. In summing up the evidence to the jury on Wednesday, Lord Coleridge said Sir C. Wilson had a right to read Mr. Burleigh's message, and Mr. Smith had a right to read Sir C. Wilson's, but as to sending it on Sir C. Wilson might complain of it, or Sir E. Malet, but not the Central News. After a short absence the jury returned into court with these findings upon the points submitted to them: 1. That Sir C. Wilson did make use indirectly of the plaintiff's messages. 2. That defendants did not divulge the plaintiff's message to their damage. The Attorney-General submitted that upon these findings the defendants were clearly entitled to a verdict. Lord Coleridge said he would reserve that for argument. He should not now leave the question of damages to the jury, but would still reserve judgment. Mr. Moulton applied for and was allowed costs, to be taxed upon the higher scale.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Simplex Electric Light and Plant Company, Limited.—The statutory return of this company, made up to the 11th ult., was filed on the 30th ult. The capital is £40,000 in £5 shares, including 1,200 fully paid shares allotted to the vendor; the number of shares taken up is 3,450. Upon 2,250 the sum of £2 per share has been called, the calls paid amounting to £10,450, leaving £50 unpaid. Registered office: Carlton Buildings, 17, Cooper Street, Manchester.

North-Eastern Electric Light and Power Company, Limited.—The second return of this company, made up to the 20th of February, was filed on the 29th ult. The nominal capital is £100,000 divided into 5,000 preference and 15,000 ordinary shares of £5 each. 140 ordinary shares have been allotted, and £4 per share has been called thereon, the calls paid amounting to £490, leaving £70 unpaid. The registered capital of the company is £210 in excess of the amount recorded in the previous return. Registered office: 61, John Street, Sunderland.

DISSOLUTION OF PARTNERSHIP.

Crompton, R. E. B. and **Thomson, H. L.**, electrical engineers and manufacturers, Chelmsford, and Mansion House Buildings, London.

CITY NOTES, REPORTS, MEETINGS, &c.

The River Plate Telephone and Electric Light Company, Limited.

THE report of the directors for the year ending January 31st, states that on that date the number of paying exchange and private wire subscribers in Buenos Ayres and Montevideo was 1,573, the annual value of the rentals being about £27,000, showing an increase for the year of 573, or 57 per cent., in the total number of paying subscribers, and an increase of £10,000, or 59 per cent., in the total annual value of rentals. The net revenue is set down at £7,067, showing an increase of £2,592. An interim dividend on the 9 per cent. cumulative preference shares was paid up on the 30th of April, 1883, and the board recommend a dividend on the preference shares at the rate of 9 per cent. up to the 31st of January last, leaving £8,308, from which it is proposed to write off the following amounts:—Preliminary and London expenses, as per last account, £2,231: office furniture, £33; and depreciation of plant, £1,000. The balance of £5,043 remains to be carried forward.

Electrical Power Storage Company, Limited.

AN extraordinary general meeting of this company was held on Thursday, at the offices, 4, Great Winchester Street Buildings, for the purpose of confirming the resolution reducing the capital, passed at the meeting held a fortnight ago. Sir Daniel Cooper presided.

The Chairman moved the confirmation of the resolution, "That the capital of the company be reduced from £800,000 divided into 200,000 shares of £4 each to £200,000 divided into 200,000 shares of £1 each, and that such reduction be effected by reducing the nominal amount of every share from £4 to £1."

Mr. J. S. Sellon seconded, and the resolution was carried unanimously, the meeting then terminating.

Great Northern Telegraph Company of Copenhagen.

AT the annual general meeting held at Copenhagen, on the 26th April, 1884, F. Zahle, Esq., presided.

The Chairman, C. F. Tietgen, Esq., in opening his address to the meeting, with regard to the company's business during the past year, remarked that he saw no occasion to tire those present with a specific list of the different interruptions of the company's cables, the more so as these interruptions had not interfered either with the company's capability to transmit the traffic as usual, or with the ordinary receipts accruing from the latter. Notwithstanding these interruptions, of which the greater part occurred in the latter half of the year, the condition of the cables had, on the whole, been satisfactory, and the engineers had, with the help of the company's ships, effected the repairs very promptly, and also effectually supervised the state of the cables.

What had, however, contributed most to the equanimity with which the directors could look upon these interruptions, was mainly the progress made in the perfecting of the company's system, which had taken place last year, partly by the duplication of the Hongkong-Shanghai cable, which had been undertaken by the Eastern Extension Telegraph Company, partly, and mainly, by the company's duplication of the cables between Shanghai, Nagasaki and Wladiwostock. The new Hongkong-Shanghai cable was already opened for traffic between these two places on the 23rd May, and on the 18th of June it was further carried into Foochow, thus bringing this important commercial place into connection with the company's cable system. The manufacture of this company's new Shanghai-Nagasaki-Wladiwostock cables was commenced in January last year by the Telegraph Construction and Maintenance Company, in London, under the supervision of the company's engineers. The cables were then shipped on board and successfully laid from that company's cable steamers, the *Scotia* and the *Seine*, and all connections were finally completed in September.

The company had further undertaken, for their own account, the establishment of a cable communication between Japan and Corea, a cable which starts from the eastern coast of the Island of Kiusiu, connecting Nagasaki with Fusan on the western coast of Corea and touching at the Islands of Iki and Tsusima. It was owing to a convention between Japan and Corea, that the company had been placed into the position to connect telegraphically these two countries, of which the latter had lately been opened to Europeans. What the financial result of this undertaking would be for the company, depended, of course, upon the future development of Corea.

In Europe the company had also laid a new cable, viz: between Sweden and Russia, thus triplicating the existing connection. This cable, which had been laid in the month of September, by the company's own steamer, the *H. C. Orsted*, will henceforth be the means of greater security on a route which is of great importance to the company, and where repairs to cables in winter time, while the Gulf of Bothnia is covered with ice, can only be effected with great difficulty.

On the whole, it would be seen that the company had, during the past year, besides giving their full attention to the development of the traffic, also shown great activity in rendering the whole cable system as complete as possible. The number of the company's cables now amounted to 17, not reckoning intermediate sections, and the total length of the same was 6,162 nautical miles. All cables in the Far East had, as it were, been duplicated, and although the original cables, now 13 years old, had constantly been maintained and renewed as occasions arose, the knowledge of the existence of a duplication by new and strong cables would be very reassuring to the shareholders.

The confident expectations as to the future financial results, which the board expressed at the last general meeting, had been justified. As the statistics would show, the gross telegraph receipts for the past year had been 6,362,200 francs, about £255,000, or about £13,200 more than in 1882. This satisfactory increase had not only been owing to the effects of the duplication itself, as referred to, but also to exceptional correspondence called forth by political events in connection with the Tonkin affair.

Political events had also contributed very much to the development of telegraphic enterprise in the interior of China. During last year, several land lines of great importance had been constructed in China; thus from Tientsin to Tungchow, a few miles from Pekin, from Shanghai to Ningpo (in the present year extended to Foochow), &c., whilst at the present moment a line was being built between Canton and Foochow, and between Nankin and Hankow, and lines to Pekin and Paotingfoo were contemplated.

The chairman might refer to an interesting but less important matter, viz., that the company had taken part in the Electrical Exhibition at Vienna, by successfully exhibiting apparatus and instruments manufactured in their own workshops at Copenhagen.

During the past year the company had also come to the conclusion that it would be desirable to issue new share warrants. The coupons on the old warrants had now been exhausted, and as such new sheets would thus at any rate have to be issued, it had been considered advisable to print new complete warrants with the coupon sheets attached, not only because the warrants of 1872 had been gradually dilapidated, but also as objection had been taken to the French translation label which had been affixed to the back of many of the warrants. The share warrants would, therefore, in future appear not only with the English and Danish, but also with the French text imprinted on the front.

From the balance sheet, which had already been placed before the shareholders, it would appear that after the ordinary charges for interest and amortisation of debentures, the payment of the usual 5 per cent. interim dividend during the past year, &c., had been provided for, there remained an amount of £127,033 5s. 2d., which the directors submitted to the meeting to deal with as follows: £45,833 6s. 8d. to be divided amongst the shareholders as an extra dividend of 3 per cent. (making the dividend for the year, including the interims already paid, 8 per cent.); £55,555 11s. 1d. to be added to the reserve and renewal fund, and £25,644 7s. 5d. to be carried forward to next year's account.

In the division of the net earnings of the company it will have been observed that the exceptional amount of £2,222 4s. 6d. has been allotted to the pension fund of the staff. The object had been to strengthen that fund, in a prosperous year like the past, in order that it may efficiently fulfil the intentions of the company when the fund was started. It was, however, understood that the extra allowance would be subject to certain changes in the rules and regulations which appear to be necessary.

The company had great regret in announcing that Vice-Admiral Steen Bille had died in the spring of last year. The Admiral had consented to act as an auditor from the very formation of the company, and had since then shown the warmest sympathy in the well-being of the company. The company had, in the meantime, requested Mr. J. A. Garde, formerly Governor of the Danish West Indian Islands, a gentleman who had always taken a great interest in the company, to act as shareholders' auditor for the year 1883.

Without discussion the report was then unanimously adopted, the accounts were passed, and discharge given to the board of directors.

The retiring director, Julius Sick, Esq., was re-elected.

A. Berner, Esq., was re-elected, and J. A. Garde, Esq., was elected as shareholders' auditors.

The Hammond Electric Light and Power Supply Company, Limited.

AN extraordinary general meeting of this company was held on Wednesday at the works, Appold Street, Finsbury, Sir Charles Young, presiding.

The Chairman moved the confirmation of the following resolutions, passed at a previous general meeting:—

1. "That the nominal capital of the company, which now consists of the sum of £330,000, divided into 66,000 shares of £5 each, be increased to the sum of £525,000, and that this amount be divided into 350,000 shares of the nominal value of £1 10s. each.

2. "That 50,123 shares of the nominal value of £1 10s. each, forming part of the said capital of £525,000, be issued as fully paid up, and that the same be applied in manner following, that is to say:—(*a.*) 40,133 of the said £1 10s. shares ratably to the present holders of the 40,133 ordinary £5 shares in this company. (*b.*) 7,990 of the said £1 10s. shares to the holders of the 15,980 deferred £5 shares in this company, and 2,000 of the said £1 10s. shares to the holder of the founder's shares in this company."

3. "That the directors be empowered to enter into such agreements or contracts as may be necessary for the carrying out of all or any of these special resolutions, and to issue and allot the balance of the authorised nominal capital of the company from time to time, on such terms and conditions as they in their discretion may think fit."

4. "That an indenture bearing date the 19th day of March, 1884, and made between the Hammond Electric Light and Power Supply Company, Limited, of the one part, and Robert Hammond of the other part, be and the same is hereby ratified and confirmed."

The resolutions were carried unanimously, and, Mr. Hammond having stated that since their last meeting they had got their works for the manufacture of incandescent lamps into such full operation that they had issued a circular announcing that they were ready to supply such lamps of their own make, up to 100 volts, at 3s. 6d. per lamp net, the meeting terminated with a vote of thanks to the chairman.

The Maxim-Weston Electric Company, Limited.

A GENERAL meeting of this company was held at the City Terminus Hotel, on the 2nd instant, but, as our reporter was refused admission, we are unable to give our own account of what took place. We may mention that the refusal to admit reporters was accompanied by an intimation that, as the company's own reporter was present, an account of the proceedings would be forwarded. Such an account we have received, consisting mainly of the speech of Mr. Hugh Watt, the chairman. We are sure that under such circumstances our readers will attach no value to that which may or may not have been manipulated, and will prefer that we should not burden our columns with the reproduction of that which, in the eyes of business men, can only be accepted with extreme caution.

Should any one pecuniarily interested in this company be desirous of obtaining the report above alluded to, it will be found published in the *Financier* of May 6th.

Great Northern Telegraph Company of Copenhagen.—The company's bankers, Messrs. C. J. Hambro & Son, No. 70, Old Broad Street, London, E.C., are now prepared to issue new share certificates, with fresh coupon sheets, in exchange for the old certificates, which are to be given up with the talon attached. The old certificates should be accompanied by detailed duplicate lists, and left three clear days, for examination, with the bankers, from whom forms of lists can be obtained. Shareholders, whose certificates are registered "to name" at any of the company's offices, should endorse the shares with their names. In exchange they will receive new certificates to "bearer," which may, however, at any time be registered to name, at the London office 119, Bishopsgate Street Within, free of charge.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of April was 3,80, estimated to produce £3,300, against 4,413 messages, producing £3,982 in the corresponding month of last year. The receipts for the month of January, estimated at £3,000, realised £3,009.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of April, 1884, are £1,800, against £1,778 in the corresponding period of last year.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 30th April are £3,190 as compared with £3,544 in the corresponding period of 1883.

The Great Northern Telegraph Company. The receipts in April, 1884, £21,040; from 1st January to 30th April, 1884, £8,1640; corresponding months, 1883, £77,922; 1882, £72,350.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 2nd, 1884, were £2,990, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending April 30th, 1884, £3,465.

PROCEEDINGS OF SOCIETIES.

Physical Society, April 26th, 1884.

Dr. GUTHRIE, President, in the chair.

New Members: Mr. Chattock, Mr. Inwards.

PROFESSORS PERRY and AYRTON read a paper on the indicator diagram of a gas engine, which was intended to teach practical engineers a new method of studying gas engine diagrams. The most recent results obtained by the use of Dowson gas were stated, and it was suggested that before long gas engines will be employed for the propulsion of ships. A large wooden model of an Otto gas engine enabled the operations going on during a cycle of the engine to be understood. Tables were given of the constituents of coal gas and Dowson gas, the air required for combustion, the heat of combustion, and the specific heats to enable the characteristic equation of the fluid used in the gas engine to be determined. An easy method of obtaining one empirical formula to represent all the diagrams which can be obtained from an engine with different quantities of gas was described and its results compared with observation. The effects of vibration of the indicator spring in the various parts of the diagram were discussed as well as the effect of the last explosion, which are provided for in the empirical formula. Three practical methods of determining the rate, q, of gain of heat by the fluid during the forward stroke were given, and a diagram was shown in which this rate could everywhere be compared with the rate of doing work. If w is the indicated work in one cycle, it was shown that 5·64w. is the total energy of combustion of one charge and this is expended as follows: 1·45w. is the work done in the forward stroke, 2·22w. is given to the cylinder by radiation in the forward stroke, 1·5w. is carried off through the exhaust pipe, 0·47w. is given to the cylinder as heat after exhaust valve opens. The rate at which the loss, 2·22w., by radiation occurs at every point of the forward stroke was shown on a diagram obtained from a knowledge of the temperature at every point in the stroke, and when the ordinates of this diagram were added to the q diagram previously described, a diagram was obtained showing at every point of the stroke the rate at which combustion was going on. This diagram was specially important as showing the effect of dissociation in the gas engine.

Dr. W. H. STONE exhibited a simple form of siphon mercurial barometer with metrical scale. Two millimetre scales are adjusted to slide easily side by side; the lower edge of one is brought on a level with the mercury in the shorter limb, and the other slid up and down until its lower edge coincides with the upper mercury surface. The adjustment is easily effected by an

observer, without stooping, by the use of two right-angled glass prisms fitting on the upper and lower ends of a vertical glass tube.

The next meeting of the society, on May 10th, will be held in the Mason College, Birmingham.

Berlin Physical Society, March 21st.

DR. FRÖLICH made mention of some modifications of the Wheatstone bridge which had been applied to the measurement of the internal resistance of galvanic elements and batteries. Of the two diagonals of the bridge one contained a battery of constant electromotive force, the other the galvanometer. In these circumstances the resistances of the four lateral wires showed the proportion $w_1 : w_3 = w_2 : w_4$. For the purpose of measuring the resistance in a galvanic battery, the arrangement was so far empirically changed that the battery to be measured was inserted in one of the lateral wires. A second empirical method consisted in inserting the galvanometer into one diagonal wire and interrupting the second; the battery to be measured was placed in a lateral wire. Dr. Frölich showed that both arrangements were only modifications of Wheatstone's bridge. The way in which these modifications originated might be conceived by supposing that the bridge was formed of cords, and that the angles of the square were successively shifted; the proportion which applied to Wheatstone's bridge would still hold in the new case. Dr. Frölich laid down a general law applicable to all individual cases. If in a Wheatstone bridge an element be inserted into each wire, while one diagonal wire contained the galvanometer, and the other was interrupted, if, moreover, on opening this wire, the electromotive force in the other diagonal remained unchanged, then the proportion above stated between the resistances of the lateral wires would still hold. Whether this general law included such a case as could be applied practically and with certainty to the measurement of the resistance of elements must be determined by experience.

NEW PATENTS—1884.

7032. "Dynamo-electric manhines." W. E. GEDGE. (Communicated by C. J. Van Depoele.) Dated April 30. *(Complete.)*

7048. "Galvanic batteries." P. R. DE FANCHEUX D'HUMY. Dated April 30.

7049. "Carbons for galvanic batteries." P. R. DE FANCHEUX D'HUMY. Dated April 30.

7081. "Steno-telegraphy and apparatus employed therein." W. H. BECK. (Communicated by G. A. Cassagnes.) Dated May 1.

7113. "Electric stamp for post marking, or for other like purposes of obliteration." N. FREEE. Dated May 1.

7139. "Incandescent electric lamps." E. L. ROUSSY. Dated May 2.

7185. "Dynamo-elcctric machines." E. JONES. Dated May 3.

7212. "Electrical indicator, register and tell-tale." P. JOLIN. Dated May 5.

7244. "Arranging electric light appliances with portable furniture, such as chairs, sofas and settees." A. GRAY. Dated May 5.

7254. "Voltaic cell, or element." J. IMRAY. (Communicated by W. Wenzel.) Dated May 5. *(Complete.)*

7310. "Distribution and controlling electrical currents." L. A. V. PELLEGRIN. (Communicated by G. Carette.) Dated April 3.

7311. "Driving dynamo-electric machines uniformly." L. A. V. PELLEGRIN. (Communicated by G. Carette.) Dated April 3.

7312. "Microphone." K. S. DEMBINSKI. Dated May 6.

7314. "Galvanic batteries and arrangements in connection with them." J. ENRIGHT. Dated May 6.

7315. "Conducting a current of electricity to or from a train in motion." J. ENRIGHT. Dated May 6.

7335. "Anti-induction system for telegraph cables and wires." R. N. LAWRIE. (Communicated by P. H. Van Der Weyde.) Dated May 6. *(Complete.)*

7347. "Telephone transmitters." W. R. LAKE. (Communicated by H. Clay.) Dated May 6. *(Complete.)*

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

4319. "Electrical generators." F. C. GLASER. (Communicated by A. I. Gravier, K. Luedtke, and Grether, of Russia.) Dated September 8. 2d. Relates mainly to the construction or building up of armatures for electrical generators of all kinds, whether they are in the form of rings or cylinders, discs, or drums, but the invention is also applicable to the construction of the inducing or field-magnets of electrical machines. *(Provisional only.)*

1884.

839. "Improvements in electric motors." S. P. THOMPSON. Dated January 7. 6d. The improvement consists in placing in certain positions, with respect to the brushes which supply the current to the armature, a certain combination of electro-magnets and pole-pieces.

923. "An insulating compound for electrical purposes generally." H. J. ALLISON. (Communicated from abroad by J. Greives and J. H. Bleoo, of America.) Dated January 8. 2d. Relates to certain improvements in the insulating material patented May 29, 1883, No. 2651, and consists, in the use of oxides, carbonates, silicates, sulphates, and other insoluble salts of magnesium, strontium and barium, in combination with melted rosin, to form an insulating substance for application to any electrical construction.

2285. "Improvements in holders for incandescent electric lamps." C. DORNFELD. Dated January 28. 6d. This invention consists in a new construction of holders or so called "settings" for incandescent electric lamps. The object of the construction is to enable the lamp holders to be conveniently screwed on to gaseliers, chandeliers, &c., to fit the conducting wires in the lamp holder in a commodious way, to protect the same from contact or any external disturbance, as well as to fix the lamp itself into the holder in the simplest way and thereby to ensure its contact with the conductors.

2632. "Improvements in induction coils and contact breakers therefor." J. B. THISTLETON. Dated February 2. 4d. The invention consists of two principal parts, which may be called the coil, and the current interrupter. The coil consists of a bobbin of wood, metal, ebonite, or other similar material, on which is wound a helix, or helices of copper, iron, german silver, or other wire. In the centre of the coil is inserted, a rod, tube, or bundle of iron. The wire used is not insulated with gutta-percha, cotton, or silk, as is usually the case, but is used uncovered and is insulated by being imbedded in paraffin or other similar material, during or after the process of winding the wire upon the coil. The interrupter consists of two metal arms both of which are attached to one end of the coil; thus rendering the current interrupter entirely independent of the surrounding woodwork; one of these arms carries a metal spring, the other arm carries a stud faced with platinum and a sprung washer, the position of this stud with regard to the vibrating spring may be varied by means of a slot in the brass arm, or an eccentric movement of the stud, thus allowing the rapidity of the interruptions of the current to be greatly varied, or the platinum faced stud to be entirely drawn out of contact with the vibrating spring, and so preventing waste of the battery when the apparatus is not in use. The length of the slot in the aforesaid arm, or the amount of movement of the eccentric, determines the possible variations of the rapidity of the interruptions of the current.

2707. "Improvements in automatic telegraphy." W. P. THOMPSON. (A communication from T. F. Taylor, of America.) Dated February 5. 6d. The objects of the invention are, to provide means for insuring that the characters which are employed to represent the messages to be transmitted, and which are usually formed upon chemically prepared paper at the receiving station with great rapidity, through the agency of electric currents transmitted from the sending station, shall be clearly defined and of uniform distinctness, to organise a complete office system, whereby any number of different operators may be simultaneously engaged in preparing the messages for transmission, and the messages thus prepared be successively transmitted over a single main conductor without entailing any material delay in changing from the transmission of one dispatch to another; to provide means whereby different receiving instruments may be placed in circuit with the main line with the same facility; and in general the aim of the invention is to organise the apparatus at the station of an automatic telegraph system, in such a manner as to meet all the requirements of a convenient, expeditious, and available service.

3106. "Improvements in and relating to apparatus for protecting electric circuits and instruments therein from injury by excessive charges produced by lightning or otherwise." (Communicated from abroad by J. W. Dyer, of America.) Dated February 11. 6d. By this invention should the line-wire become overcharged by lightning and the electric charge have considerable tension but small quantity, then the coils of a magnet magnetise the core and cause the armature to be attracted. This action causes a contact-bar to touch two brushes, thus connecting the line to earth through coils and shunting the telegraphic apparatus.

3159. "Improvements in and relating to means for insulating and protecting electric wires or conductors." W. R. LAKE. (Communicated from abroad by W. W. Averell, of America.) Dated February 12. 6d. This invention relates to means for insulating and protecting electric wires and conductors, and comprises an insulating asphaltic-concrete conduit for the reception and protection of electric wires of all descriptions, and an improved compound for the said conduit and for insulating electric wires.

3210. "Improvements in electric arc lamps." H. W. PENDRED. Dated February 13. 6d. The descent of the upper carbon is controlled by wheels and a fan or fly, and a brake or detent. These wheels and fan or fly, brake or detent, are mounted in a frame or "cage," which swings on centres concentric with those of one of the herein-before-mentioned wheels. On the axis of this wheel may be fitted a pinion gearing into a rack on the upper carbon holder, so that the movement of the said carbon holder will cause that of the wheel. The lower end of this cord is secured to the upper carbon holder near its lower end, and the upper end of the cord is secured to a tension spring hooked to the upper carbon holder near the top, said tension spring serves to keep the cord tight, and prevent it from slipping on the roller. The cord and roller are the equivalent of a rack and pinion, but work more smoothly. The wheel before mentioned is mounted loose on the axis and is caused to revolve with it in one direction by a ratchet wheel and click. When the upper carbon is raised by hand the teeth of the ratchet wheel pass freely under the click; and the wheels and fly or brake wheel herein-before-mentioned are put in motion or driven by this ratchet wheel and click. Under one end of the herein-before-mentioned frame or "cage" is fixed a solenoid in the main circuit, and the core of the said solenoid is suspended from the frame or "cage." Thus as the core rises or falls in the solenoid the frame or "cage" will swing on its centres which are concentric with those of the great wheel. In any convenient position is fixed a stop, against which the brake or detent rests, when the before-mentioned solenoid core has been partly withdrawn from the solenoid. The contact of the brake or detent with the said stop releases the wheels in the "cage," and permits the descent of the upper carbon holder. Lamps thus constructed may be worked in multiple arc or singly.

3249. "Improvements in the preparation of selenium for, and the manufacture of, selenium cells for electrical purposes, and apparatus therefor." (Communicated from abroad by C. E. Fritts, and D. H. Hopkinson, of America.) Dated February 13. 4d. The inventor places in contact with the selenium a material which is both pervious to the radiant energy and offers a free passage for electric currents, the said material being arranged on one or both sides of the selenium formed in thin sheets so that the radiant energy, as light, acts on the surfaces or through the entire mass of the selenium in the same plane as, or general direction of, the electric current produced, controlled, or affected, by the action of the radiant energy on the selenium.

3340. "Improvements in magnets and in magnetic garments or clothing for the prevention, relief and cure of disease or other complaints of the human body, also applicable to the bodies of animals." G. CARBON. Dated February 15. 4d. In making magnets according to the invention for the production of a stronger current with a given weight of metal with also increased elasticity, the inventor forms the magnets of a number of very thin layers of metal, whether they be bar, tubular, wire, ribbon, or other magnets, *i.e.*, he takes pieces of magnetised steel, all of equal length, with their poles placed upon each other, thus building up a compound magnet with its north poles at one end and its south poles at the other.

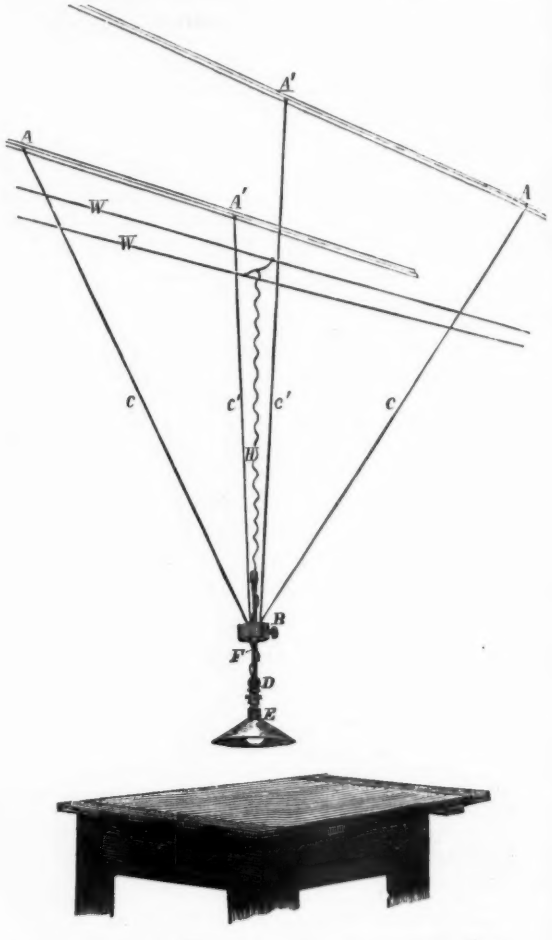
3980. "Improvement in circuit closers for telegraphic keys." J. NEIFING. Dated February 26. 4d. In the ordinary telegraphic instruments now in use by operators in sending dispatches, there is a switch which is pivotted so as to turn horizontally to one side to open the circuit while the key is being used for sending, and which is turned back to close the circuit for receiving signals. It frequently happens in practice that an operator, after using his key to send a message, forgets to turn the switch back to close the circuit. The consequence is that mischevious delays occur in receiving signals and messages. The object of the invention is to prevent such evils by providing an improved automatic closing switch that may be readily applied to any key; that will always keep the circuit closed when the key is not being used for sending; and that can readily be moved to open the circuit by the act of operating the key.

CORRESPONDENCE.

Electric Light in the Drawing Office.

In the lighting of a drawing office it is of great importance to place the lamps in such positions that they will not cast shadows from the working edges of T-squares, set-squares, and other tools. If the light is localised over every drawing-board—as, of course, it ought to be—this condition can be satisfied only by supporting each lamp so that it may be moved over all parts of the board. A pedestal support is seriously in the way, and the right plan evidently is to hang the lamp from above, but in a manner which will leave it two degrees of freedom to move horizontally. This has been very successfully done in the drawing class-room of this college, on a plan suggested by my assistant, Mr. Thomas Reid, and shown in the sketch.

An incandescent lamp is carried at the foot of a rod, F, which depends from a small wooden block, B. The block is hung by two cords, *c c*, *c′ c′*, from four points in the ceiling, A, A, A′, A′. Each of the two cords passes down and up through two vertical holes in the block, the two cords crossing each other on its lower face. This permits the block to be moved easily to any part of a surface as extensive as the spread of the points of support on the ceiling, the cords slipping through the block as it is moved, while their friction serves to keep it from returning of itself after being displaced. Further, the lamp can be raised or lowered by sliding the rod, F, up or down in the block, B, in which it is secured by a pinching-screw. A small weight at D keeps the rod vertical. A stout paper cone over the lamp reflects the light downwards and screens the eyes of the draughtsman. The current reaches the lamp by a double flexible conductor, H, from a pair of main leads, W, W, which are thick bare copper wire tightly



stretched across the room from wall to wall above a row of drawing tables, at a height sufficient to prevent the wires from being touched by the suspension cords when a lamp is displaced. Each man has his own table and lamp, and is independent of his neighbours. The lamps are Swan's 100-volt, of 20 candles, but a smaller power would suffice, as no light is wasted in illuminating spaces where it is not wanted. Over other drawing tables ranged along the walls the lamps are carried by double-jointed brackets, ending in collars through which rods similar to F slide. The system has been in use for some months. Its introduction brought about a very striking improvement in the air of the room which the burning of much gas had formerly made almost intolerable. We now have pure air and a far better light.

J. A. Ewing.

University College, Dundee,
May 3rd, 1884.

The Theory of Dynamo-Electric Machines.

I should have more pleasure in answering Mr. E. L. Voice had he advanced his objections in a more serious manner. As it is almost impossible to reply seriously to a person who seeks to refute a theory by arguments mainly of a derisive nature, I shall therefore only reply to those portions of Mr. Voice's letter relevant to the points under discussion.

Mr. Voice's statement that line of force diagrams "are likely to convey a wrong impression to the future electrical student as to the nature of magnetic force and its action on a conductor moving under its influence," is contrary to the fact that by means of iron filings diagrams taken from any magnetic combination, we can determine the relative amounts of electrical action which would take place in a conductor moved through a given part of the field in a given direction. The assertion that the line of force theory "in a few years will be swept into oblivion," must be intended hyperbolically, as this method of demonstration is becoming more and more extensively used.

Mr. Voice's "magnetic short circuits," and "other polar forces," have no connection with the line of force theory, because lines of force can only rightly be conceived to exist in non-magnetic space, and not in magnetic masses, while the "other polar forces" have not yet been discovered.

From his remarks upon the direction of magnetic lines of force I must conclude that Mr. Voice has lost sight of the fact that a magnetised needle in a magnetic field places itself along the lines of force, thus affording a means of determining their distribution without the use of iron filings, while the direction in which the N pole points indicates the "direction of flow." The arrow heads in my diagrams denote the direction in which the N pole of a magnetic needle would point were it placed in that part of the field.

With reference to the concluding paragraph of Mr. Voice's letter, I would remark that it is customary to demonstrate the action of dynamo-electric machines by means of "mere skeletons," whether lines of force are made use of or not.

According to promise, I will now describe the action of those dynamos in which the wire coils are wound upon radially projecting iron cores, taking the Lontin as typical of this class.

Figs. 1 and 2 demonstrate diagramatically the principle of action of this type of generator. In these figures N represents the pole of a fixed permanent magnet, S one end of an iron bar, around which is placed the wire-coil, A—this last being shown in section. The iron core with its surrounding coil is supposed to be approaching the magnet pole in the direction indicated

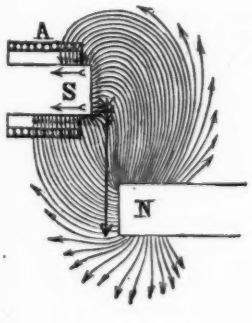


FIG. 1.

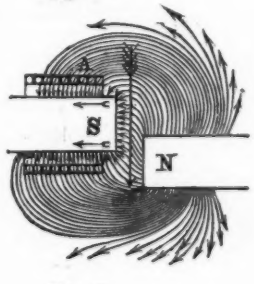


FIG. 2.

by the long arrow. In fig. 1 the bar is at some distance from the pole; in fig. 2 they are close together. As the bar approaches the magnet the lines of force entering the end of the core move along the latter in the direction shown by the small arrows, increasing in number at the same time. In their movement along the bar the lines of force cut the wires, thus generating a current in the helix,

The action of the Lontin continuous current generator is represented in fig. 3. N, S, are the two field-magnet poles; A is the armature, composed of eight iron cores projecting radially from a central cylinder; the long arrows indicate the direction of motion; the short arrows show the "direction of cut"; the arrow heads denote the "direction of flow."

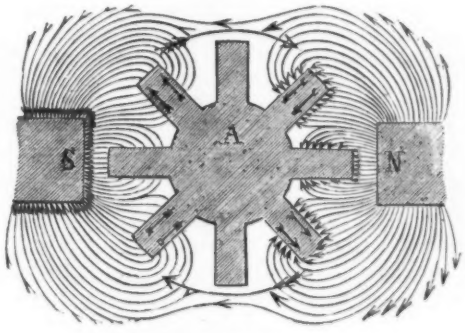


FIG. 3.

Supposing a bobbin to start from its lowest position as it rises toward the pole S, the direction of cut is from left to right, the direction of flow being from right to left. This continues till, after a quarter revolution, the bobbin begins to recede from the pole S, the direction of cut is thereupon reversed, the direction of flow remaining unchanged. The direction of cut continues from right to left till the bobbin has completed another quarter revolution, when, as it approaches the N pole of the field-magnet, the direction of cut and the direction of flow are simultaneously reversed. When the bobbin commences to recede from the N pole a reversal of the direction of cut again takes place, but without alteration of the direction of flow, which remains the same till the bobbin enters the field of the pole S, when it is reversed simultaneously with the direction of cut.

These diagrams illustrate the manner in which the actions of "pole armatures" generally should be graphically demonstrated, as this description applies equally to the armatures of Allen, Andrews, Gerard, or Lontin, and, to a certain extent, to those of Niaudet, Wallace-Farmer, Hopkinson, and most alternate current machines.

As the length of this letter is already somewhat considerable, the description of the mode of action of these generators must be left for a future communication, in which I shall endeavour to further demonstrate the wide applicability of the graphic method of delineating electro-magnetic actions.

F. de Wolffers.

May 4th, 1884.

Railway and Electric Appliance Company, Limited.

With reference to the meeting of the shareholders held on the 18th April, as reported in your issue of the 26th ult., I beg to submit the following summary and analysis of the poll taken thereafter.

Colonel Jackson and Mr. Smith did not offer satisfactory evidence that the terms of compromise are beneficial to the shareholders and that their interests and position are consistent with the interest of the company, but these gentlemen employed the tactics of introducing irrelevant matters relating to other companies and other affairs and made denials as to their personal relationship to the company which are vague and entirely unsupported. Mr. Smith stated that some of the statements contained in the circular and pamphlet issued to the shareholders were not true, but offered no proof which would impeach the evidence to the contrary. The remainder of Mr. Smith's remarks were of a personal character and I need only refer to them at present and say that my

connection with this company and the Williams Company, to which Mr. Smith refers, is open to the closest examination and scrutiny. The circulars and pamphlet which have been issued to the shareholders were referred to by Colonel Jackson as "extremely amusing documents," but the only attempt which Colonel Jackson made to reply to the statement submitted was with reference to the balance-sheet.

This balance-sheet he professed to be unable to comprehend and characterised "as a mass of absurdities," but time will show whether such is the case.

Colonel Jackson stated that the number of proxies held by the directors were so considerable that they could outvote and checkmate the attempt to govern the affairs of the company in opposition to the course proposed by the directors.

The result of the poll was as follows :—

Ordinary General Meeting.

Resolution for adoption of the report.

For the resolution	57,917
Against	25,216
Majority	32,701

Extraordinary General Meeting.

Special resolution.

For the resolution	58,287
Against	25,116
Majority	33,171

In analysing this poll it will be found that out of the 57,917 shares voted in support of the directors and the terms of compromise, 40,450 were fully paid shares which the directors in their report informed the shareholders were transferred to Colonel Elliott and Colonel Jackson in trust for the company, and that 11,644 were held by the vendors, promoters, and those specially connected with them, leaving a balance of 5,823 shares; of this number 3,700 were held by the directors and their personal friends, the remaining 2,123 shares to be accounted for presumably represent independent shares, provided the 1,000 shares of Mr. Arrol are not included in these 2,123. The 25,216 shares voted against the resolution contains 17,500 referred to by Colonel Jackson, leaving a balance of 7,616 shares, in which 4,000 shares of the Maxim-Weston Company are included.

Such facts characterise the terms of compromise, and the value of Colonel Jackson's remarks with reference to the votes he controlled at the meeting can be readily estimated, and a simple examination of these suggestive figures renders further comment unnecessary at present.

Various statements in public print make it appear that at the adjourned meeting for declaring the poll, Colonel Elliott said "that the resolution was not carried by the requisite majority, although that was practically of no consequence."

In view of proceedings in accordance with such statements the Court has been moved, and Vice-Chancellor Bacon has granted an interim injunction for the present.

J. S. Williams.

London, *May 1st*, 1884.

Time by Telephone.

I see in the ELECTRICAL REVIEW for this week a notice of *time by telephone*, supplied by a Trans-Atlantic telephone company. For the last eighteen months, however, I have had time by telephone in my private house, and have found it the greatest convenience and comfort.

In Glasgow the town clocks are controlled on Bain's system, or rather a modification of it, by a current transmitted each second from a standard clock in the University Observatory. With a little practice it is easy to hear this current by induction on almost every telephone line; and even on the least quiet lines the "tick" of the Observatory clock can be heard after eight o'clock p.m., when the post-office telegraphs have ceased for the night. In order to keep the clocks right to the second there is a "break" at the end of each minute. The impulse corresponding to the last second of the minute is omitted by the Observatory clock; and this "break" is also distinguished, of course, by the telephone. As I always know the time by my watch to less than half a minute, I can thus find the time to a second, and I do so almost every evening.

But further, my watch being a particularly good one, I like to have the time to a much more close degree of accuracy than a second; and I have tried many ways, but I have found none so satisfactory as the telephone method. I hang up my watch in front of me and observe the second's hand flitting round the dial; and I have ascertained that my watch makes five beats to the second (most watches make either ten in two seconds or else nine). By listening to the "ticks" of the clock through the telephone, and noting the position of the second's hand at the instant of the "ticks," relative to the marks on the dial, I can, without difficulty, make out the time to one-fifth of a second. By this means I have learned some curious things about the going of the best watches at different parts of the twenty-four hours, and under different circumstances.

It is obvious that in towns where time is transmitted from a standard clock to the public clocks it would be easy to supply it also to the telephone subscribers. I have proposed to the local telephone company here to bring the clock current into the Exchange, and let it pass round a coil which would form a "primary." A secondary coil passing round this primary would form in the Exchange a subscriber, called "clock." Any other subscriber on being connected to "clock" can obtain the time correct to a second. An operator in the Exchange can supply the minute; or this can readily be done by a striking arrangement. I have already ascertained by experiment that primary and secondary just described give admirable results.

The University, Glasgow, *May 3rd*, 1884. **J. T. Bottomley.**

The Efficiency of Dynamos.

I am sorry to see that Mr. C. F. Heinrichs appears to ignore the "several small sources of loss" which are inherent, in different degrees, to dynamos of all types, when calculating the efficiency of conversion of his dynamo. I pointed out in a letter to your contemporary, the *Electrician*, of March 22nd, that there existed in reality two efficiencies of conversion as well as two commercial efficiencies, the one set taking into account the various sources of loss due to friction, windage, &c., and the other eliminating the same. In so far as the commercial efficiencies are concerned, I am glad to find that Messrs. Alabaster and Gatehouse also hold this view, which they have expressed in the tabulated trials alluded to by Mr. Heinrichs.

If efficiency of conversion means anything at all, it means that percentage of the mechanical power absorbed by a machine which reappears as electrical energy in the total circuit. The more limited view taken by Mr. Heinrichs is doubtless useful as a means of comparison between different arrangements of iron and copper, but that is all. It is conceivable that a dynamo might be so arranged as to show a high efficiency of conversion when viewed in this light, falling to a very low figure when the power required to revolve its complicated structure was taken into account. Living, as we do, at a time when no man's opinions or property are safe from unmerited attack, I would point out to Mr. Heinrichs that the above remarks are applicable to all dynamos, and are penned to bring about, if possible, a more uniform and comprehensive method of tabulating dynamo trials than that which has done duty in the past.

R. E. Dunston.

Kentish Town, *May 5th*, 1884.

[We may comment on this in our next.—EDS. ELEC. REV.]